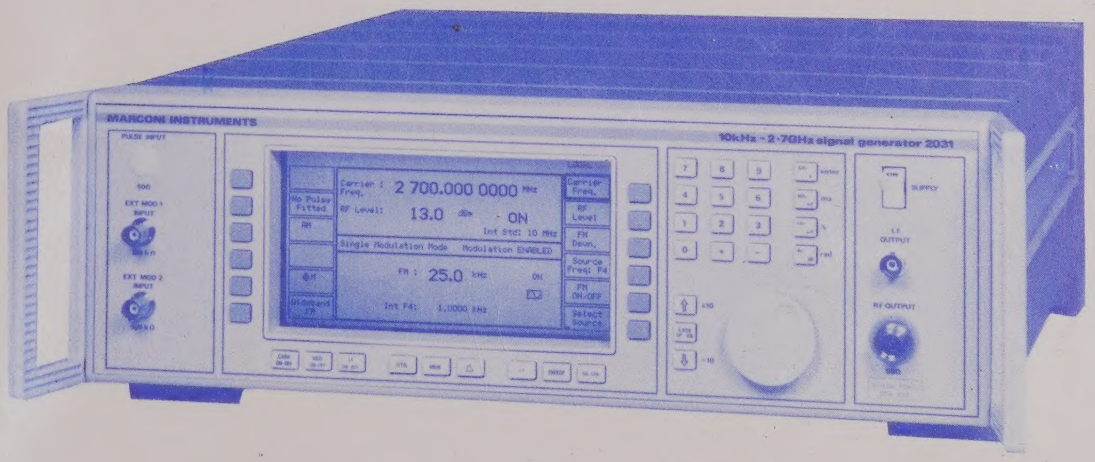
Marconi
Instruments

2030 SERIES

AM/FM SIGNAL GENERATORS



Operating Manual

MANUAL CHANGE C3

for

Operating Manual

SIGNAL GENERATORS

2030 SERIES

Manual part no. 46881-976P

Issue 6

SERIAL Nos... All PROTOS Issue 9

FIRST CHANGE

This change applies only to instruments fitted with software version 2.007 and higher. The software update improves the effective intermodulation performance. Make the following changes to the manual.

General

On all Figs. with menu displays showing the soft key *No Pulse Fitted*; change to read *Low Intermod*.

Page 3-1-15

Insert the following section immediately before 'Selecting pulse modulation':

'Low intermodulation mode

When carrying out intermodulation tests the output signal from two signal generators is combined using a resistive or hybrid combiner. If the carrier frequencies are relatively close together each generator will receive an interfering signal from the other source. The RF ALC system will detect a beat frequency equal to the difference in carrier frequencies and attempt to apply AM in order to cancel the signal. In so doing the RF ALC system will generate AM sidebands which are indistinguishable from intermodulation products. Using the Low Intermodulation Mode the RF ALC system can be disabled to prevent the injection of AM sidebands.

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If pulse modulation is not fitted proceed as follows:

(1) At the Sig Gen menu press *[Low Intermod]*.

(2) This causes either *Low Intermodulation Disabled* or *Low Intermodulation Enabled* to be displayed in the lower panel.

(3) Press the MOD ON-OFF key to toggle between the enabled and disabled states.

(4) If an attempt is made to *[Set Steps]* from the Δ menu, the message *Low Intermod: No Steps Allowed* will be displayed.

If pulse modulation (Option 002) is fitted proceed as follows:

(1) Press the *[Pulse Mod]* key.

(2) This causes the message *PULSE ON* to be displayed.

(3) Press the *[Pulse ON/OFF]* key.

(4) This causes *PULSE OFF* to be displayed together with *Low Intermodulation Disabled* or *Low Intermodulation Enabled* shown in the lower panel.

(5) Press the MOD ON-OFF key to toggle between the enabled and disabled states.

(6) If an attempt is made to *[Set Steps]* from the Δ menu, the message *PULSE : No Steps Allowed* will be displayed.

Note...

AM is not available in the Pulse Modulation or Low Intermodulation modes of operation.'

Page 3-1-40

Change to read as follows:-

'Note...

The LF output is entered as V/mV/μV/dBmV representing--'

Page 3-2-12, MODULATION MODE

Add to Note...

'For instruments without pulse modulation (Option 002) fitted select Low Intermodulation mode by using character data type PULSE.'

Page 3-2-18, PULSE MODULATION

Change PULSE:OFF to read:

'Turn Pulse modulation OFF and select Low Intermodulation'

Page 3-2-28, LF GENERATOR LEVEL

Under LFGL :VALUE change to read:

'Allowed suffices: V,MV,UV,DBMV'

S E C O N D C H A N G E

This change applies only to instruments fitted with software version 2.008 and higher. The software update enables the LF level to be set in units of dBm. Make the following changes to the manual.

Page 3-1-35

Change Fig. 3-1-27 *'RF Level Units'* box to read *'Level Units'*.

Page 3-1-37

Change **RF level units** to read:

'RF level units

With the instrument unlocked to Level 1, pressing *[Level Units]* displays the *RF Level Units Selection Menu* as shown in Fig. 3-1-29.'

Change Fig. 3-1-29 to show in the box at bottom left the annotation *LF Level Units*.

Page 3-1-38

Add to end of first para:

'Pressing *[LF Level Units]* displays the *LF Level Units Selection Menu.*'

Add the following text and figure immediately before **'RF offset'**:

'LF level units

Pressing the *[LF Level Units]* soft key at *RF Level Units menu* calls up the *LF Level Units menu*, see Fig. 3-1-29b. To select a linear, EMF, unit press one of the **[V]**, **[mV]** or **[μV]** hard keys. To select a logarithmic one, dBm or dBV relative to a volt or millivolt EMF press the **[dB]** key. To change

the units from e.g. dBm to dBmV EMF, press the soft key next to the unit required, i.e. *[dBmV EMF]*. When *[dBm]* is selected, the additional information *(600 ohms)* is displayed. The selected units should then be saved to the non-volatile memory using the *[Save LF Units]* key. Press *[EXIT]* to return to the *RF Level Units Selection Menu.'*

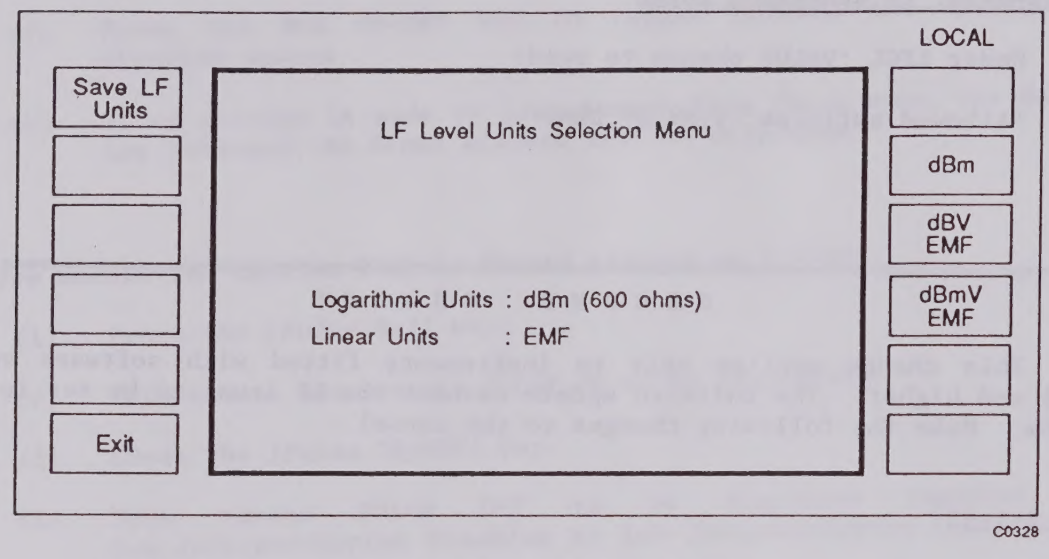

Fig. 3-1-29b LF Level units selection menu

Page 3-1-40

Change to read as follows:-

'Note...

The LF output is entered as V/mV/μV or dBm/dBV/dBmV representing the ---'

Page 3-2-11

Under **RFLV?** change references to 'UNIT' in 3 places to read 'UNITS'.

Page 3-2-28

Under **LFGL** immediately before the examples add:

':UNITS	Select default LF level units
Data type:	Character Program Data (DBM,DBV,DBMV,V,MV or UV)
Allowed suffices:	None
Default suffix:	None'

Replace the **LFGL?** section with the following:

'LFGL?

Prepares the message containing information on LF Generator Level setting in the following format:

:LFGL:UNITS<unit>;VALUE<nr2>;INC<nr2>

where:

<unit> is character programmed data defining the default LF level units (DBM,DBV,DBMV,V,MV or UV).

Example: :LFGL:UNITS MV;VALUE 125.8;INC 1.0'

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SIGNAL GENERATORS
2030 series

2030 10 kHz to 1.35 GHz
2031 10 kHz to 2.7 GHz
2032 10 kHz to 5.4 GHz

Includes information on:
Option 001 - Second LF oscillator
Option 002 - Pulse modulation
Option 003 - +19 dBm RF output level

This manual applies to instruments with software issues of 2.001 and higher.

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Issue 6

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PREFACE

WARNINGS, CAUTIONS and NOTES

These terms have specific meanings in this manual:-

WARNINGS contain information to prevent personal injury.
CAUTIONS contain information to prevent damage to the equipment.
Notes contain important general information.

HAZARD SYMBOLS

The meaning of hazard symbols appearing on the equipment is as follows:

Symbol	Nature of hazard	Reference in manual
	Dangerous voltages	Page vi
	Static sensitive components	Page vii
C0081	Beryllium	Page vii
None	Lithium batteries are used in this equipment. Appropriate caution should be exercised when handling these items.	Page vii

MANUAL AMENDMENT STATUS

Each page in this manual bears the date of its original issue or, if it has been amended, the date and status number of the amendment. Any changes subsequent to the latest amendment status are included on Manual Change sheets coded C1, C2 etc. at the front of the manual.

OPERATING PRECAUTIONS

This product has been designed and tested in accordance with IEC Publication 348 - 'Safety Requirements for Electronic Measuring Apparatus'. To keep it in a safe condition and to avoid risk of injury, observe the following WARNING notices. To avoid damage to the equipment, observe the CAUTION notices.

WARNING - ELECTRICAL HAZARDS

AC supply voltage. This equipment conforms with IEC Safety Class 1, which means that it is provided with a protective earthing lead. To maintain this protection, the AC supply lead must always be connected to the source of supply via a socket with an earthing contact. Make sure that the earth protection is not interrupted if the supply is connected through an extension lead or an autotransformer.

Before fitting a non-soldered plug to the AC supply lead, cut off the tinned end of the wires, otherwise cold flowing of the solder could cause intermittent contact.

Do not use the equipment if it is likely that its protection has been impaired as a result of damage.

Fuses- Primary and secondary. Note that there is a supply fuse in both the live and neutral wires of the supply lead. If only one of these fuses should rupture, certain parts of the equipment could remain at supply potential.

Make sure that only fuses of the correct rating and type are used for replacement. Do not use mended fuses or short-circuited fuse holders.

To provide protection against breakdown of the supply lead, its connectors and filter (if fitted), an external supply fuse with a continuous rating not exceeding 6 A should be used in the live conductor (e.g. fitted in the supply plug).

Removal of covers. Disconnect the supply before removing the covers to avoid the risk of exposing high voltage parts. If any internal adjustment or servicing has to be carried out with the supply on, it must only be performed by a skilled person who is aware of the hazard involved.

Remember that capacitors inside the equipment may still be charged after disconnection of the supply. Those connected to high voltage points should be disconnected before carrying out work inside the equipment.

CAUTION - PULSE INPUT

Before switching the instrument on, ensure that no signal voltage is present on the PULSE INPUT socket.

WARNING - OTHER HAZARDS

Parts of this equipment are made from metal pressings, therefore it should be handled with due care to avoid the risk of cuts or scratches.

Some of the components used in this equipment may include resins and other materials which give off toxic fumes if incinerated. Take appropriate precautions, therefore, in the disposal of these items.

Beryllia (beryllium oxide) is used in the construction of the following components in this equipment:

TR2 and TR3 on board AB3/5 (2031)
TR111 and TR206 on board AB3/4 (2032)
TR315 on board AB2/2 (2030, 2031 and 2032)

This material, if incorrectly handled, could cause a danger to health - refer to the service manual for safe handling precautions.

A **Lithium** battery is used in this equipment. This presents two hazards.

(1) As lithium is a toxic substance, the battery should in no circumstances be crushed, incinerated or disposed of in normal waste.

(2) If the battery is rapidly discharged there is a risk of explosion. Take care, therefore, to avoid short circuiting the battery.

CAUTION - LCD HANDLING

Take care not to depress the front or rear faces of the display module as this may damage the liquid crystal display elements. To clean the display, use a soft cloth moistened with ethyl alcohol or isopropyl alcohol. Do not use acetone, turpentine, thinners, paraffin or any abrasive material as these could damage the bonded polarizer.

CAUTION - STATIC SENSITIVE COMPONENTS

This equipment contains static sensitive components which may be damaged by handling - refer to the service manual for handling precautions.

CAUTION - TILT FACILITY

When the instrument is in the tilt position, it is inadvisable for stability reasons, to stack other instruments on top of it.

CAUTION - INTEGRITY SEALS

If, during the warranty period of this product, an integrity seal is broken by removing the covers, for example, the warranty may be invalidated.

Similarly, if a module with a broken seal is returned on an exchange basis, it will not be acceptable under the terms and conditions of the exchange service.

Chapter 1

GENERAL INFORMATION

INTRODUCTION

The 2030 series Signal Generators cover the frequency ranges 10 kHz to 5.4 GHz with three models: 2030 (10 kHz to 1.35 GHz), 2031 (10 kHz to 2.7 GHz) and 2032 (10 kHz to 5.4 GHz). A dot matrix display with soft key selected screen options allow flexibility of operation and ease of use. The output may be amplitude, phase, or frequency modulated with pulse modulation available as an option. Modulation is available using a combination of up to two external signal inputs and a built-in LF source (a second internal source is optional).

Microprocessor control ensures that the instruments are flexible and easy to use and allows programming by the General Purpose Interface Bus (GPIB). The GPIB is designed to IEEE Standard 488.2 and is a means of sending commands to an instrument, via a data bus, from a remote controller or personal computer. The instruments can therefore be used manually or as part of a fully automated test system.

Fig. 1-1 10 kHz to 2.7 GHz Signal Generator 2031

MAIN FEATURES

Operation

Selection of parameters on the screen may involve one or more of the numeric, hard or soft keys or the rotary knob. Hard keys have single or dual functions which remain constant throughout, whereas soft keys have functions dependent on the present mode of operation. Parameters may be set to specific values by numeric key entry, while values may be varied in steps of any size using the ⇑/⇓keys or altered by moving the knob, set to a particular sensitivity.

The SIG GEN, LF, SWEEP, MEM (memory), Δ (delta) and UTIL (utility) menus are selectable, at any point of operation, via the keys below the display panel. Within the display, the soft key functions are indicated by labels which appear alongside the keys situated at either side of the display panel.

Display

The display is a dot matrix liquid crystal panel, with backlighting. Carrier frequency, modulation and RF level are shown in horizontal regions on the principal screen. The display features 11-digit resolution for carrier frequency, 4-digit for RF level and 3-digit for modulation, with unit annunciators.

Contrast may be varied, using the control knob, to optimize the viewing angle. Differing lighting conditions may be accommodated using the backlight intensity function, variable from no backlight to full intensity. A full graphical display test is available, refer to the Service Manual.

Frequency selection

Carrier frequency is selected via the soft key option on the SIG GEN display and direct entry via the keyboard. Alternatively, selection may be made via the General Purpose Interface Bus (GPIB). Frequency resolution is 0.1 Hz across the band. Carrier frequencies can be stored in a non-volatile memory with complete recall when required. An ON-OFF key is provided to completely disable the output.

Output

RF output up to +13 dBm can be set by direct keyboard entry on the SIG GEN display or via the GPIB, with a resolution of at least 0.1 dB over the entire range with a basic level accuracy of ±1 dB. A factory fitted option is available to extend the output level to +19 dBm on the 2030 model.

A choice of calibration units is available to the operator and provision is made for the simple conversion of units (for example, dBm to μV). Calibration data for the output level is held in memory and may be altered from the front panel or over the interface bus.

The output level can be offset by up to ±2 dB by keyboard entry. Offsets from the calibrated value may be used to compensate for cable or switching losses external to the generator. This facility can be used as a means of deliberately offsetting the output level to ensure that all generators in an area give identical measurements. While using the offsetting facility, the principal calibration of the generator is not lost and may be returned to at any time.

An electronic trip protects the generator output against reverse power of up to 50 W, preventing damage to output circuits when RF or DC power is accidently applied.

Modulation

Comprehensive amplitude, frequency (plus wide bandwidth FM), phase and optional pulse modulation are provided for testing a wide range of receivers. An internal modulation oscillator is provided, having a frequency range of 0.1 Hz to 500 kHz, with a resolution of 0.1 Hz. A second modulation oscillator can be included as an option. Two independent BNC inputs on the front panel allow external modulation signals to be mixed with the internal signal(s). Therefore, a maximum of four modulation sources may be available at one time. These

sources may be combined to give the single, dual, composite and dual composite modes, see 'MODULATION MODES', Chap. 3-1.

The signalling facility allows testing of radio equipment with sequential and sub-audible tone capability. The sequential calling tone system is accessible from the utility menu for all four modulation modes. Sub-audible calling tones are specified within the modulation source select display.

Incrementing

All major parameters can be incremented or decremented in step sizes entered via keyboard entry or the GPIB. If no step size is entered for a parameter, the steps are preset to 1 kHz for carrier frequency, 1 kHz for modulation oscillator and LF frequency, 1 kHz for FM deviation, 1% for AM depth and 1 dB for output level.

In addition the rotary control can be used to vary the parameter with the sensitivity of the knob being changed by means of the ×10 and ÷10 keys.

Sweep

The sweep capability of the 2030 Series allows comprehensive testing of systems. Four parameters are used to specify sweep; start, stop, number of steps and time per step. These are specified by the user, with upper and lower limits for the parameter values being dependent on the function. The sweep markers menu is available by soft key selection on the sweep display, allowing the placement of up to five user defined markers.

Non-volatile memory

The non-volatile memory allows 50 complete instrument settings, 50 partial settings, 100 carrier frequency settings, 20 sweep settings and 20 signalling tone sequences to be stored for later use at any time.

Programming

A GPIB interface is fitted so that all functions are controllable via the interface bus which is designed to the IEEE Standard 488.2. The instrument can function both as a talker and a listener.

Protection

To prevent accidental interference with the contents of internal memories, internal data is protected by a secure key sequence.

Two levels of protection are offered, appropriate to the function being accessed. The most secure is reserved for features which alter the calibration data of the instrument. The first level of protection is less severe, enabling the user to access functions which are relevant to normal operation, such as selecting the RF level calibration units, RF level offsets and external standard frequency.

Spectral purity

With an SSB phase noise performance at of typically -122 dBc/Hz at 470 MHz (20 kHz offset), the 2030 Series can be used for both in-channel and adjacent channel receiver measurements. Harmonically related signals and non-harmonics are better than -30 dBc and -70 dBc respectively.

Calibration

The 2030 Series has a two year calibration interval and is calibrated entirely by software. The calibration display is available via soft key selection at the utilities menu.

Options

An additional modulation oscillator is available to enable greater flexibility. This second oscillator has the same specification as the first and allows full use of complex modulation modes.

Pulse modulation is also optional. This extra facility allows radar RF and IF stages to be tested. Selection is from the SIG GEN display, with pulse modulation switched on and off by the MOD ON/OFF key.

A further option is available which extends the output level to +19 dBm on the 2030 model.

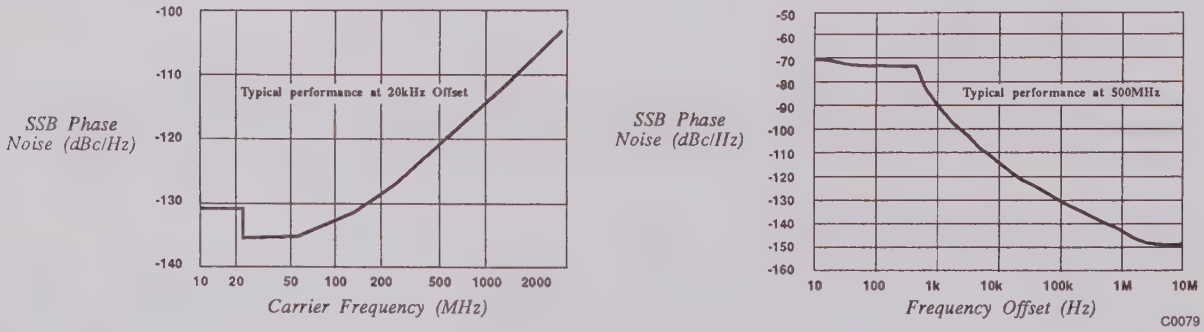


Fig. 1-2 Typical phase noise performance of 2030 Series

PERFORMANCE DATA

CARRIER FREQUENCY

Range

10 kHz to 1.35 GHz (2030);
10 kHz to 2.7 GHz (2031);
10 kHz to 5.4 GHz (2032).

Selection

By keyboard entry of data. Variation by ⇑/⇓ keys and by rotary control.

Indication

11 digits with annunciators.

Resolution

0.1 Hz.

Accuracy

As frequency standard.

Phase incrementing

The carrier phase can be advanced or retarded in steps of π/128 (approximately 1.4°) using the rotary control.

RF OUTPUT

Range

-138 dBm to +13 dBm (2030);
-138 dBm to +19 dBm (2030 with Option 003);
-144 dBm to +13 dBm (2031 & 2032).

When AM is selected the maximum output level reduces linearly with AM depth to +7 dBm (+13 dBm for 2030 with Option 003) at maximum AM depth.

Selection

By keyboard entry of data. Variation by ⇑/⇓keys and by rotary control. Units may be μV, mV, V EMF or PD; dB relative to 1 μV, 1 mV EMF or PD; dBm. Conversion between dB and voltage units may be achieved by pressing the appropriate units key (dB, or V, mV, μV).

Indication

4 digits with unit annunciators.

Resolution

0.1 dB.

Accuracy

	<1.35 GHz	1.35-2.7 GHz	2.7-5.4 GHz
Above 0 dBm:	±0.65 dB*	±1 dB	±1.5 dB
Above -50 dBm:	±1 dB*	±2 dB	±2 dB
Above -100 dBm:	±1 dB*	±2 dB	±3 dB
Above -127 dBm:	±1 dB*	±2 dB	-

*2030 with Option 003: ±1.2 dB for output levels greater than -127 dBm.

VSWR

For output levels less than 0 dBm:
Less than 1.25:1 to 2.2 GHz (return loss greater than 19.1 dB);
Less than 1.4:1 to 2.7 GHz (return loss greater than 15.6 dB);
Less than 1.5: 1 to 5.4 GHz (return loss greater than 14 dB).

Output protection

An electronic trip protects the generator output against reverse power of up to 50 W from a source VSWR of up to 5:1.

Output connector

50 Ω nominal, N-type female socket.

SPECTRAL PURITY

At RF levels up to +7 dBm :-

Harmonics	Better than -30 dBc for carrier frequencies to 1 GHz. Better than -27 dBc for carrier frequencies to 5.4 GHz. Better than -27 dBc for carrier frequencies to 1.35 GHz for 2030 with Option 003.
Sub-harmonics	Better than -90 dBc to 1.35 GHz. Better than -40 dBc to 2.3 GHz. Better than -30 dBc to 5.4 GHz.
Non-harmonics	Better than -70 dBc to 5.4 GHz for offsets from the carrier frequency of 3 kHz or greater.
Residual FM (FM off)	Less than 7 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at 470 MHz.
SSB phase noise	Less than -116 dBc/Hz (typically -122 dBc/Hz) at an offset of 20 kHz from a carrier frequency of 470 MHz.
RF leakage	Less than 0.5 μV PD generated at the carrier frequency across a 50 Ω load by a two turn 25 mm loop, 25 mm or more from the case of the generator with the output terminated in a 50 Ω sealed load.
FM on AM	Typically less than 100 Hz for 30% AM depth at a modulation frequency of 1 kHz and a carrier frequency of 500 MHz.
ΦM on AM	Typically less than 0.1 radian10 at a carrier frequency of 500 MHz for 30% AM depth for modulation rates up to 10 kHz.

MODULATION MODES

Four modulation modes are available:

Single	FM, Wideband FM, ΦM, AM or pulse (optional).
Dual	Two independent channels of differing modulation type (e.g. AM with FM).
Composite	Two independent channels of the same modulation type. (e.g. FM1 with FM2).
Dual composite	A combination of Dual and Composite modes providing four independent channels (e.g. AM1 with AM2 and FM1 with FM2).

FREQUENCY MODULATION

Deviation	Peak deviation from 0 to 1 MHz for carrier frequencies up to 21.09375 MHz; Peak deviation from 0 to 1% of carrier frequency above 21.09375 MHz.
Selection	By keyboard entry of data. Variation by ⇑/⇓ keys and by rotary control.
Indication	3 digits with annunciators.

Displayed resolution	1 Hz or 1 least significant digit, whichever is greater.
Accuracy at 1 kHz, internal modulation	±5% of indication ±10 Hz excluding residual FM.
Accuracy at 1 kHz external modulation	±5% of indication ±10 Hz excluding residual FM. With ALC off, the modulation is calibrated for an input level of 1.0 V PD RMS sine wave.
Bandwidth (1 dB)	DC to 300 kHz (DC coupled). 10 Hz to 300 kHz (AC coupled). Typical modulation bandwidth exceeds 500 kHz.
Carrier frequency offset	In DC FM mode less than ±(1 Hz + 0.1% of set deviation) after using DC FM nulling facility.
Distortion	Using external modulation without ALC: Less than 3% at maximum deviation for modulation frequencies up to 20 kHz; Less than 0.3% at 10% of maximum deviation for modulation frequencies up to 20 kHz.
Modulation source	Internal LF generator or external via front panel sockets.

WIDEBAND FM

Deviation	A rear panel input on a BNC connector allows an external modulation signal to produce up to the maximum deviation. The deviation is controlled in 3 dB steps only and the generator will display the deviation equivalent to 1 V RMS sine wave input.
Indication	3 digits with annunciators.
Selection	By keyboard entry of data. The sensitivity is controlled in 3 dB steps and the display will indicate the value of deviation nearest to the requested value.
Input level	1 V RMS sine wave to achieve indicated deviation.
Accuracy	As FM.
3 dB Bandwidth	Typically 10 MHz (DC or AC coupled).
Modulation source	External via rear panel socket (50 Ω impedance).

PHASE MODULATION

Deviation	0 to 10 radians in 0.01 radian steps.
Selection	By keyboard entry of data. Variation by ⇑/⇓ keys and by rotary control.
Indication	3 digits with annunciators.

Accuracy at 1 kHz	Better than ±5% of indicated deviation excluding residual phase modulation.
3 dB Bandwidth	100 Hz to 10 kHz.
Distortion	Less than 3% at maximum deviation at 1 kHz modulation rate.
Modulation source	Internal LF generator or external via front panel sockets.

AMPLITUDE MODULATION

For carrier frequencies up to 1 GHz (and for output levels less than +13 dBm with Option 003):

Range	0 to 99.9% in 0.1% steps.
Selection	By keyboard entry of data. Variation by ⇑/⇓ keys and by rotary control.
Indication	3 digits with annunciator.
Depth accuracy at 1 kHz	±4% of setting ±1%. Usable to 5.4 GHz.
Envelope distortion	For a modulation rate of 1 kHz: Less than 1% total harmonic distortion for AM depths up to 30% Less than 3% total harmonic distortion for AM depths up to 80%.
Modulation source	Internal LF generator or external via front panel sockets.
External AM accuracy	With ALC off the modulation is calibrated for an input level of 1.0 V PD RMS sine wave.
External AM 1 dB Bandwidth	With Modulation ALC off; DC to 30 kHz in DC coupled mode and 10 Hz to 30 kHz in AC coupled mode. Typical modulation bandwidth exceeds 50 kHz.

MODULATION OSCILLATOR

Frequency range	0.1 Hz to 500 kHz (sine wave).
Selection	By keyboard entry of data. Variation by ⇑/⇑ keys and by rotary control.
Indication	7 digits with annunciators.
Resolution	0.1 Hz.
Frequency accuracy	As frequency standard.
Distortion	Less than 0.1% THD in sine wave mode at frequencies up to 20 kHz.
Alternative waveform	A triangular wave is available in addition to the sine wave for frequencies up to 100 kHz.

Signalling tones	The modulation oscillator can be used to generate sequential (up to 16 tones) or sub-audible signalling tones in accordance with EIA, ZVEI1,ZVEI2, DZVEI, CCIR, EURO1, EEA, NATEL and DTMF* standards. Facilities are also available for creating and storing user defined tone systems. *Requires second modulation oscillator (Option 001) to be fitted.

EXTERNAL MODULATION

Two independent inputs on the front panel with BNC connectors, EXT MOD 1 and EXT MOD 2. The modulation is calibrated with 1 V RMS applied. Input impedance 100 kΩ nominal.

MODULATION ALC

The EXT MOD 1 and EXT MOD 2 modulation inputs can be levelled by an ALC system.

Level range	0.7 V RMS to 1.4 V RMS sine wave.
Distortion	Less than 0.1% additional distortion for frequencies up to 20 kHz at 1 V RMS sine wave (typically less than 0.1% up to 50 kHz).
1 dB Bandwidth	Typically 10 Hz to 500 kHz.

LF OUTPUT

Front panel BNC connector. The output may be configured in either LF Generator Mode to give an output from the internal modulation oscillator or in LF Monitor Mode to give an output from the internal modulation signal paths.

Selection	By keyboard entry of data. Variation by ⇑/⇓ keys and by rotary control.
Indication	7 digits with unit annunciators for frequency and 4 digits with unit annunciators for level.
Level	100 µV to 5 V RMS with a load impedance of greater than 600 Ω. 100 µV to 1.4 V RMS with a load impedance of greater than 50 Ω.
Common mode voltage	±0.5 V maximum.
Source impedance	5.6 Ω nominal.
Level accuracy at 1 kHz	With a load impedance of greater than 10 kΩ:- ±5% for levels above 50 mV and ±10% for levels from 500 µV to 50 mV.
Frequency response	Typically better than ±1 dB from 0.1 Hz to 300 kHz.

SWEEP

Control modes	Start/stop values of selected parameter. Number of steps. Time per step.

Step time	1 ms to 10 s per step.
Sweep ramp	Synchronized analogue ramp with an amplitude of nominally 0 to 10 V peak on rear panel BNC connector.
Markers	5 user selectable markers for frequency or level provide an indication when specified parameter values have been reached. Output 0 V to +5 V nominal from 600 Ω on rear panel BNC socket.
Trigger	Rear panel BNC connector. Applying 0 V or a switch closure starts the sweep or steps the sweep from point to point. Socket is internally connected via 10 kΩ pull-up resistor to +5 V.

FREQUENCY STANDARD

Frequency	10 MHz.
Temperature stability	Better than ±5 in 10^8 over the operating range of 0 to 50°C.
Warm-up time	Within 2 in 10^7 of final frequency within 10 minutes from switch on at 20°C .
Aging rate	Better than 2 in 10^7 per year; better than 5 in 10^{10} per day after 1 month continuous use.
Output	Rear panel BNC socket provides an output at frequencies of 1, 5 or 10 MHz with a nominal 2 V pk-pk level into 50 Ω.
External input	Rear panel BNC socket accepts an input at 1, 5 or 10 MHz with a minimum level of 2 V pk-pk level. Maximum input level 5 V pk-pk.

GPIB INTERFACE

A GPIB interface is fitted. All functions except the supply switch are remotely programmable.

Capabilities	Complies with the following subsets as defined in IEEE Std. 488.2. SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E2.

RADIO FREQUENCY INTERFERENCE

Conforms with the requirements of EEC directive 76/889 and VDE 0871 as to limits of RF interference.

SAFETY

Complies with IEC 348.

RATED RANGE OF USE
(Over which full specification is met).

Temperature	0 to 55°C.
Humidity	Up to 93% at 40°C.

CONDITIONS OF STORAGE AND TRANSPORT

Temperature	-40°C to +71°C.
Humidity	Up to 93% relative humidity at 40°C.
Altitude	Up to 4600 m (15,000 ft).

POWER REQUIREMENTS

AC supply	Four settings covering 90-115 V, 105-132 V, 188-242 V and 216-265 V. 45 Hz to 400 Hz. 160 VA maximum.

CALIBRATION INTERVAL

2 years.

DIMENSIONS AND WEIGHT

(Over projections but excluding front panel handles):

Height	Width	Depth	Weight
152 mm 6 in	425 mm 16.6 in	525 mm 20.5 in	16.5 kg 36 lb

SECOND MODULATION OSCILLATOR OPTION

Specification as Modulation Oscillator.

PULSE MODULATION OPTION

Modulation modes	Pulse modulation may be used alone or in conjunction with FM, ΦM or Wideband FM.
Switching speed	For carrier frequencies above 21.09375 MHz less than 15 ns (typically 5 ns) from 10% to 90%. For carrier frequencies below 21.09375 MHz less than 25 ns from 10% to 90%.
Control	0 to +1 V for carrier off, +3.5 to +5 V for carrier on.
Maximum input level	+5.0 V.
ON/OFF Ratio	Better than 70 dB, typically exceeds 80 dB.
Additional level error	Less than ±0.5 dB.
Propogation delay	Typically 80 ns from PULSE INPUT to RF OUTPUT pulse.
Input impedance	50 Ω nominal.

+19 dBm RF OUTPUT LEVEL OPTION

For 2030 model only.

RF OUTPUT

Range	-138 dBm to +19 dBm. When AM is selected the maximum output level reduces linearly with AM depth to +13 dBm at maximum AM depth.

SPECTRAL PURITY
At RF levels up to +7 dBm:

Harmonics	Better than -27 dBc.

VERSIONS, OPTIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering numbers	Versions
2030	10 kHz to 1.35 GHz Signal Generator.
2031	10 kHz to 2.7 GHz Signal Generator.
2032	10 kHz to 5.4 GHz Signal Generator.
	Options
Option 001	Second internal modulation oscillator.
Option 002	External pulse modulation.
Option 003	+19 dBm maximum RF output power (available for 2030 only).
	Supplied Accessories
43129-003W	AC supply lead.
46881-976P	Operating Manual for 2030 series.
	Optional Accessories
46881-978M	Service manual (for 2030 series).
43126-012S	RF connector cable, TM 4969/3, 50 Ω, 1.5 m, BNC.
54311-092P	Coaxial adapter N male to BNC female.
59999-163K	Precision coaxial adapter, N male to SMA female.
54411-051X	Impedance adapter, 50 to 75 Ω, BNC connectors.
54311-095C	RF connector cable, 1 m, type N connectors.
43129-189U	GPIB Lead assembly.
46883-408K	IEEE/IEC Adapter block for GPIB socket.
46884-291A	Rack mounting kit (with slides) for rack cabinets with depths from 480 mm to 680 mm.
46884-292Z	Rack Mounting kit (with slides) for rack cabinets with depths from 680 mm to 840 mm.
46884-541Y	Rack bracket kit, holds instrument in rack but does not support the instrument.

Chapter 2

INSTALLATION

UNPACKING AND REPACKING

Retain the container and packing material in case it is necessary to reship the instrument.

If the instrument is to be returned for servicing, attach a label indicating the service required, type or model number (ref. rear panel label), serial number, full details of the fault symptoms and your return address. Pack the instrument in accordance with the general instructions below.

(1) Place the lower padded fitting in the bottom of the container.

(2) Put the polythene cover over the instrument and place it in position on the padding.

(3) Place the upper padded fitting over the instrument.

(4) Wrap the container in waterproof paper and secure with adhesive tape.

(5) Mark the package FRAGILE to encourage careful handling.

Note ...

If the original container or materials are not available, use a strong double walled carton packed with a 7 to 10 cm layer of shock absorbing material around all sides of the instrument to hold it firmly. Protect the front panel controls with a plywood or cardboard load spreader. If the rear panel has guard plates or other projections, a rear load spreader is also advisable.

MOUNTING ARRANGEMENTS

Excessive temperatures may affect the performance of the instrument. Completely remove the plastic cover, if one is supplied over the case, and avoid standing the instrument on or close to other equipment which is hot.

CONNECTING TO SUPPLY

Before connecting the instrument to the AC supply, check the setting of the voltage selector switch which is an integral part of the supply connector at the rear of the instrument.

Voltage selector

The selected voltage is displayed in a window at the top of the connector. The instrument is normally despatched with the selector set to 240 V. To select another voltage, insert a screwdriver into the slot at the top of the moulding and twist slightly so that the cover is free to hinge downwards. Rotate the barrel so that the correct setting is displayed, see Fig. 2-1.

Setting	Voltage range
100 V	90 - 115 V
120 V	105 - 132 V
220 V	188 - 242 V
240 V	216 - 265 V

Fuses

The correct fuse rating for each voltage setting is as follows:

100 V to 120 V, 1.6 A-TT (1.6 amp double time lag)

220 V to 240 V, 1 A-TT (1 amp double time lag)

Fuses are cartridge type measuring 20 mm x 5 mm.

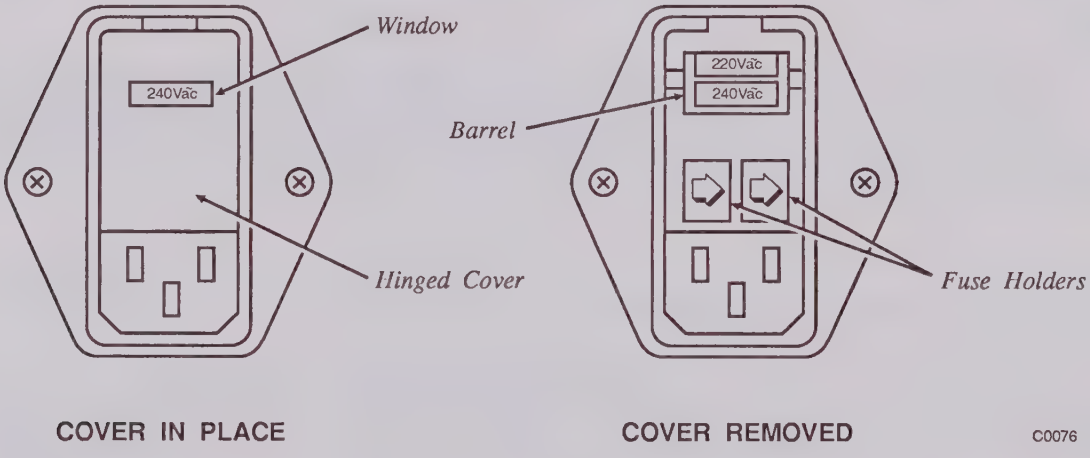


Fig. 2-1 AC connector showing voltage selector and fuse holders

Supply cable

The AC supply cable is fitted at one end with a socket which mates with the AC connector on the rear panel. When fitting a supply plug, ensure that connections are made as follows:

Earth - Green/Yellow
Neutral - Blue
Live - Brown

When attaching the supply lead to a non-soldered plug, it is recommended that the tinned ends of the lead are cut off to avoid intermittent connections resulting from cold flow.

SAFETY TESTING

Where safety tests on the AC supply input circuit are required, the following procedures can be applied. These procedures comply with BS 4743 and IEC Publication 348. Tests are to be carried out as follows and in the order given, under ambient conditions, to ensure that AC supply input circuit components and wiring (including earthing) are safe.

(1) **Earth lead continuity test** from any part of the metal frame to the bared end of the flexible lead for the earth pin of the supply plug. Preferably a heavy current (about 25 A) should be applied for not more than 5 seconds.

Test limit: not greater than 0.5 Ω.

(2) **500 V DC insulation test** from the AC supply circuit to earth.

Test limit: not less than 2 MΩ.

GENERAL PURPOSE INTERFACE BUS (GPIB)

The GPIB interface built into the 2030 series enables the signal generators to be remotely controlled to form part of an automatic measuring system.

GPIB cable connection

Connection to other equipment which has a 24-way connector to IEEE Standard 488 is made using the rear panel GPIB socket. For this purpose, the GPIB cable assembly, available as an optional accessory, (see Chap. 1 'Accessories') may be used.

GPIB connector contact assignments

The contact assignments of the GPIB cable connector and the device connector are as shown in Fig. 2-2.

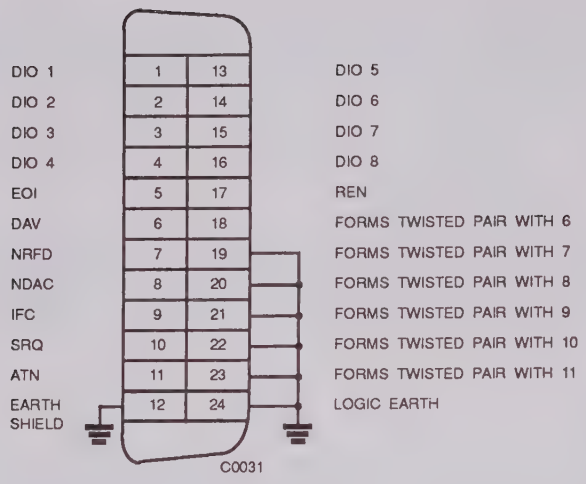


Fig. 2-2 GPIB connector contact assignments

IEEE to IEC conversion

An optional IEEE to IEC adapter is also available (see Chap. 1 'Accessories') for interfacing with systems using a 25-way bus connector to IEC Recommendation 625. The method of use is shown in Fig. 2-3.

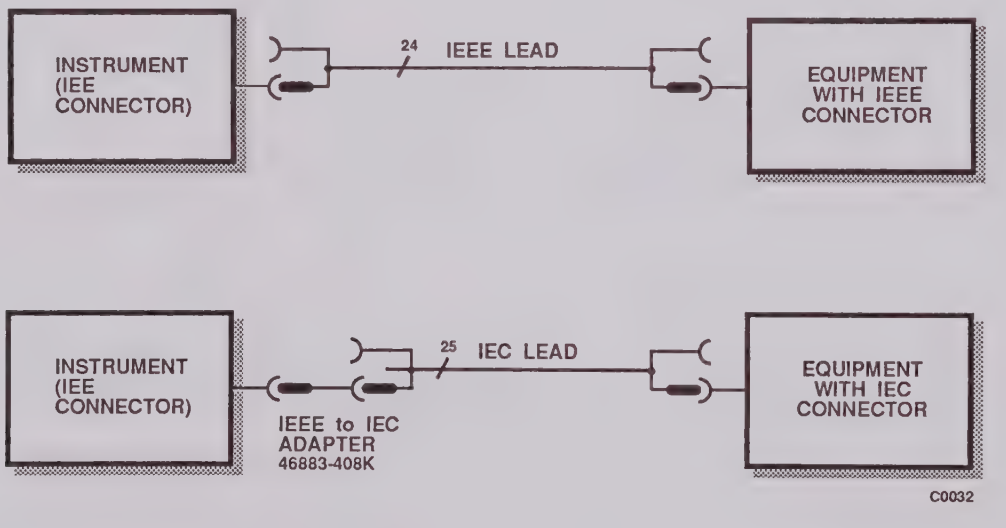


Fig. 2-3 IEEE to IEC conversion

Interface bus connection

The cables for the interface bus use special male-female connectors at both ends. This allows several connectors to be stacked one on top of another permitting several cables to be connected to the same source and secured by a lockscrew mechanism. Too large a stack, however, may form a cantilevered structure which might cause damage and should be avoided. The piggyback arrangement permits star or linear interconnection between the devices with the restriction that the total cable length for the system must be:-

(1) No greater than 20 m (65 ft).

(2) No greater than 2 m (6 ft) times the total number of devices (including the controller) connected to the bus.

RACK MOUNTING

The instrument, which is normally supplied for bench mounting, may be mounted in a standard 19 inch rack (see 'Optional Accessories'). There are two slide rack mounting kits to accommodate different depths of cabinet as well a rack bracket kit used just to hold the instrument in place in the rack. These kits include full fitting instructions.

BATTERY REPLACEMENT

The Lithium battery has an estimated life of 5 years, but it is recommended that it should be replaced every two years. The clock will continue to run for approximately 30 seconds while the replacement is made.

If a Lithium battery is unobtainable an alkaline battery can be used, but will have a shorter life.

Chapter 3-1

OPERATION

INTRODUCTION

This chapter explains how to:

- Set up the signal generator to produce a typical basic signal.
- Select the main operating parameters; carrier frequency, output level and type of modulation.
- Use the full range of supporting facilities.

CONVENTIONS

The following conventions are used in this chapter:

RF OUTPUT	Capitals refer to titles marked on the panel.
[MEM]	Capitals in square brackets indicate hard key titles.
Int. F4	Italics refer to data or messages on the display.
[Pulse]	Italics in square brackets indicate soft key titles, e.g. *[Pulse]* means the soft key adjacent to the *Pulse* title box at the side of the menu.

FRONT PANEL

Parameters are selected by means of hard keys, which have their function printed on them, soft keys, which do not have any notation, a numerical key pad and a rotary control knob, see Fig. 3-1-1. The hard keys have functions which do not change, whereas the soft key functions are determined by the menu which is being displayed. The numerical keys are used to set parameters to specific values which can also be varied in steps of any size by using the ⇑/⇓ keys or the rotary control knob.

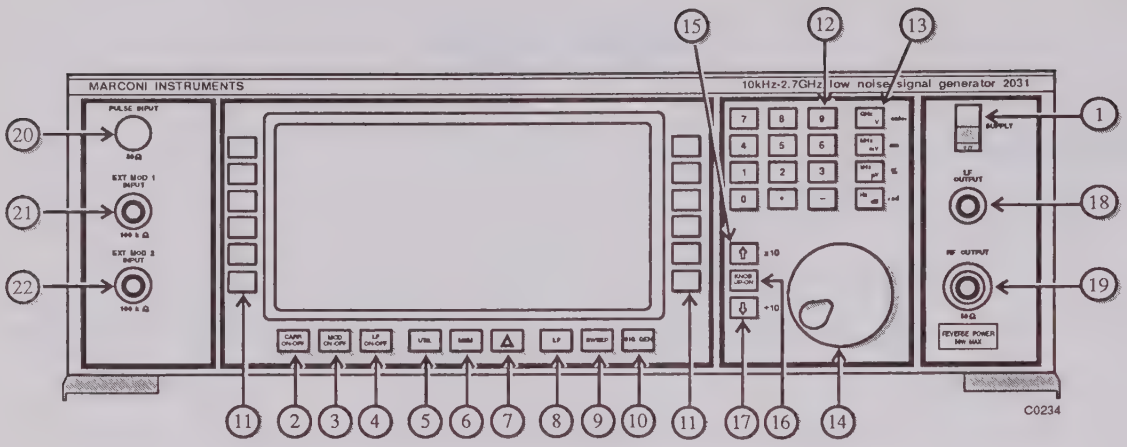


Fig. 3-1-1 2031 front panel.

(1)	supply	Switches the AC supply voltage on and off.
(2)	CARR ON-OFF	Enables or disables the carrier frequency.
(3)	MOD ON-OFF	Enables or disables the modulation.
(4)	LF ON-OFF	Switches the low frequency output on and off.
(5)	UTIL	Displays the utilities menu.
(6)	MEM	Displays the memory store/recall menu.
(7)	Δ	Displays the total shift menu.
(8)	LF	Displays the LF and monitor menus.
(9)	SWEEP	Displays the sweep status menu.
(10)	SIG GEN	Displays the main menu.
(11)	SOFT KEYS;	Twelve function keys change notation as the menu changes.
(12)	NUMERICAL KEY PAD	For changing the value of a selected parameter. Minus sign and decimal point are included.
(13)	UNITS KEYS	Determine the units of set parameters and terminate the numerical entry.
(14)	CONTROL KNOB	When enabled, adjusts the value of the selected parameter.
(15)	⇑ ×10	When knob disabled, increments a selected parameter. When knob enabled, increases knob sensitivity by value of ten.
(16)	KNOB UP-DN	Switches between control knob and ⇑⇓ keys.

(17)	⇑ ÷10	When knob disabled, decrements a selected parameter. When knob enabled, decreases knob sensitivity by value of ten.
(18)	LF OUTPUT	BNC socket provides a low impedance output at the frequency selected at the *LF GENERATOR MENU* or monitors the modulating signal.
(19)	RF OUTPUT	50 W N type socket with reverse power protection.
(20)	PULSE INPUT	50 W BNC socket (if fitted) accepts a pulsed signal.
(21)	EXT MOD 1 INPUT	100 kΩ BNC socket. An independent input which allows an external modulation signal to be applied.
(22)	EXT MOD 2 INPUT	100 kΩ BNC socket, similar to (21).

REAR PANEL

The following facilities are available on the rear panel, see Fig. 3-1-2.

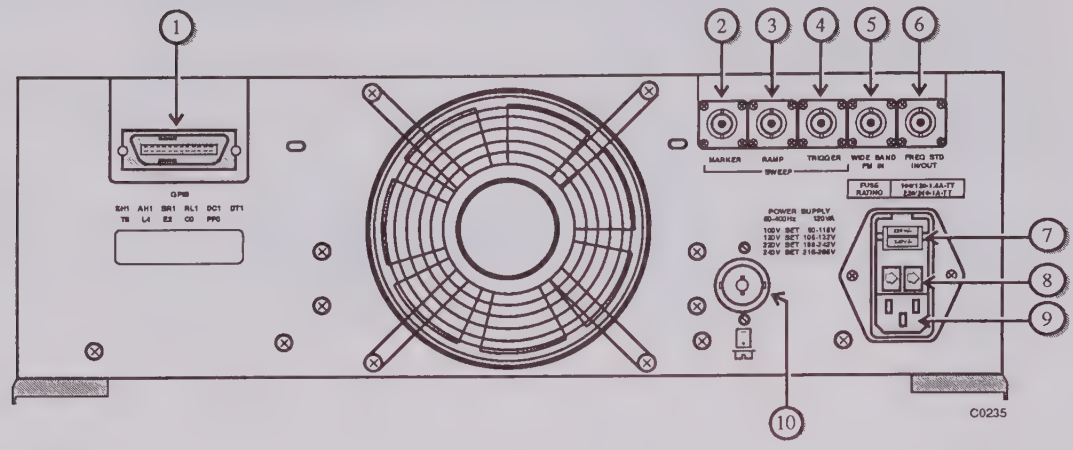


Fig. 3-1-2 2031 rear panel

(1)	GPIB	24 pin socket accepts standard IEEE connector to allow remote control of the instrument.
(2)	SWEEP MARKER	BNC socket supplies sweep marker.
(3)	SWEEP RAMP	BNC socket provides a ramp output at 0 to 10 V peak to peak.
(4)	SWEEP TRIGGER	BNC socket provides access for a trigger input.
(5)	WIDE BAND FM IN	BNC socket accepts a wide bandwidth FM signal into 50 Ω with a typical bandwidth of 10 MHz.
(6)	FREQ STD IN/OUT	BNC socket for standard frequencies at 1, 5, or 10 MHz at TTL levels.
(7)	VOLTAGE SELECTOR	Removable cover reveals barrel which can be rotated to select the required voltage range.
(8)	FUSES	AC fuses rated at 1.6 A (time lag) for the 100 to 120 V range and 1 A (time lag) for the 220 to 240 V range.
(9)	AC SUPPLY INPUT	3 pin plug integral with voltage selector and fuse holders. Mates with supply lead socket.
(10)	BATTERY HOLDER	Houses battery for real time clock.

THE MENUS

The 2030 Series instruments are operated by calling up various displays or menus on the screen. Menus are accessed via both hard and soft keys. Pressing a hard key normally causes the appropriate primary menu to appear on the screen regardless of the current working position within the menu hierarchy. As the display changes from one menu to another, so the 12 soft keys assume those functions necessary to drive the instrument from that menu. Secondary menus are displayed by pressing a soft key while in a primary menu. Some sub-menus are nested e.g. UTILITIES. Clearance from these is obtained by pressing the *[EXIT]* key.

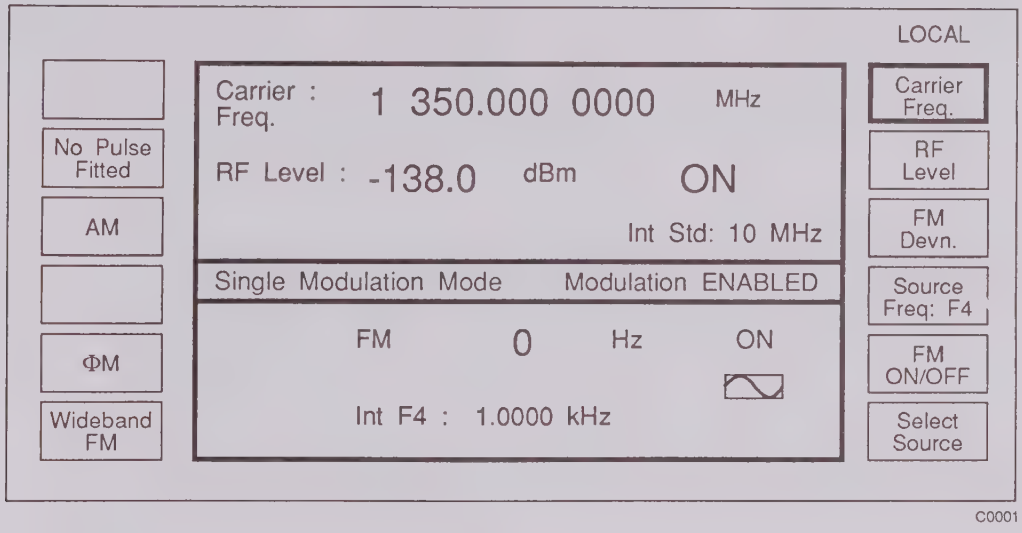


Fig. 3-1-3 Sig Gen menu - default display for 2030

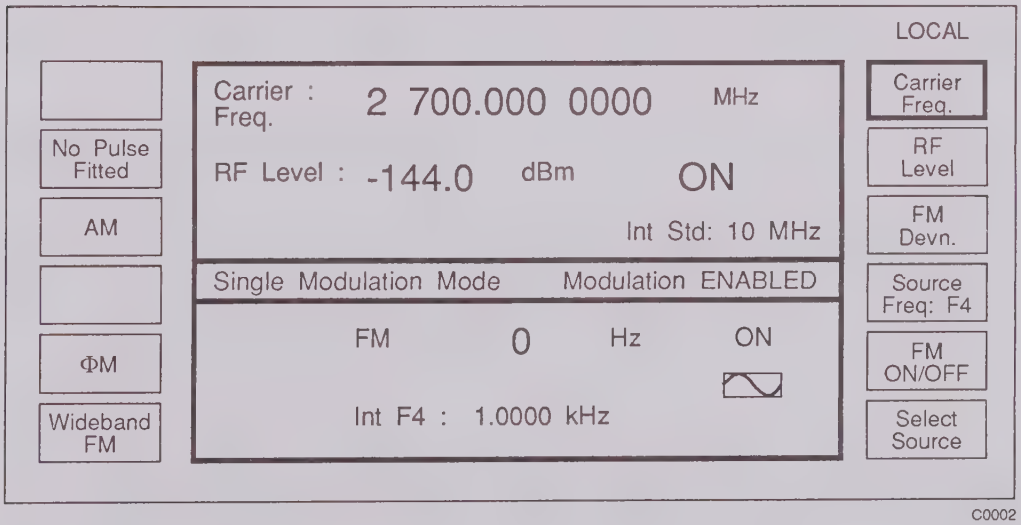


Fig. 3-1-4 Sig Gen menu - default display for 2031

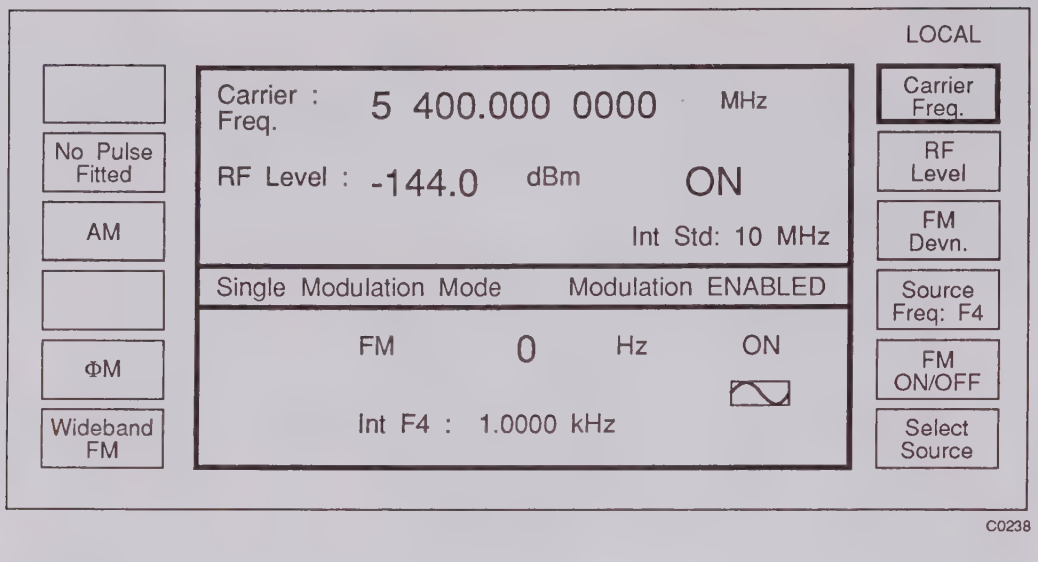


Fig. 3-1-5 Sig Gen menu - default display for 2032

FIRST TIME USE

First time users can quickly become familiar with the principles of control and display by carrying out the following exercise, which demonstrates how to set up a typical basic signal having the following parameters:

Carrier frequency:	100 MHz.
Output level:	10 dBm.
Amplitude modulation:	30% depth at 1 kHz.

Switching on

(1) Before switching the instrument on, check that the voltage selector has been set to the value of the power supply as described in Chap. 2, and that no signal voltage is present on the PULSE INPUT socket.

(2) If the default display shown in Fig. 3-1-3 or Fig. 3-1-4 or Fig. 3-1-5 is not obtained, a previous user may have set the instrument to switch on with one of the user memories recalled rather than using the default factory settings. Before proceeding any further you should reset this selection, see 'Power up options'. Switch off and on again. Alternatively use the MEM key followed by entering 50 and terminating by pressing the [enter] key. This will reset the instrument to the factory default setting.

If the RF level units and the internal/external standard are not as shown, they can be changed as described on Page 3-1-37, 'RF level units' and Page 3-1-35 'Selection of frequency standard'.

(3) Observe that the main menu appears on the display showing default parameters for FM. The soft key label marked *[Carrier Freq]* is highlighted (i.e. the line bordering the label is increased in thickness to about 1 mm), which means that anything entered at this stage will change the carrier frequency.

(4) If necessary, adjust the display for brightness and contrast, see 'UTILITIES' Page 3-1-32.

Changing the value of the selected parameter

If an error is made when keying in, press the soft key again and key in the correct value. If an error message is displayed, it can be cancelled by entering a value which is within limits.

(1) Using the numerical key pad, enter 100 MHz by pressing keys [1], [0], [0] and the key marked [MHz/mV/ms]. Observe that the Carrier Freq. display changes to *100.000 0000* MHz.

(2) Press *[RF level]*. The *RF level* soft key label is now highlighted.

(3) Using the numerical key pad, enter 10 dBm by pressing keys [1], [0] and the key marked [Hz/dB/rad]. Observe that the RF Level display changes to *10.0 dBm.*

(4) Press *[AM]* on the left hand side of the display. The menu will now change to display AM modulation parameters in the lower panel. The *[FM Devn.]* soft key on the right hand side of the menu changes to *[AM depth]* and this label is now highlighted. *AM* disappears from the left hand side.

(5) Using the numerical key pad, enter 30% AM depth by pressing [3], [0] and [kHz/µV/%]. Observe that the *AM* depth display changes to *30%*. The display will now be as in Fig. 3-1-5 and the selected signal will now be present at the RF OUTPUT socket.

Enabling or disabling the modulation

The modulation is ON by default, but the AM can be turned ON and OFF by pressing *[AM ON/OFF]* at the right hand side of the display and the modulation can be enabled or disabled by pressing [MOD ON-OFF]. These are both toggle actions, i.e. press ON, press OFF. The soft key acts only on the selected modulation whereas the [MOD ON-OFF] acts on all modulations.

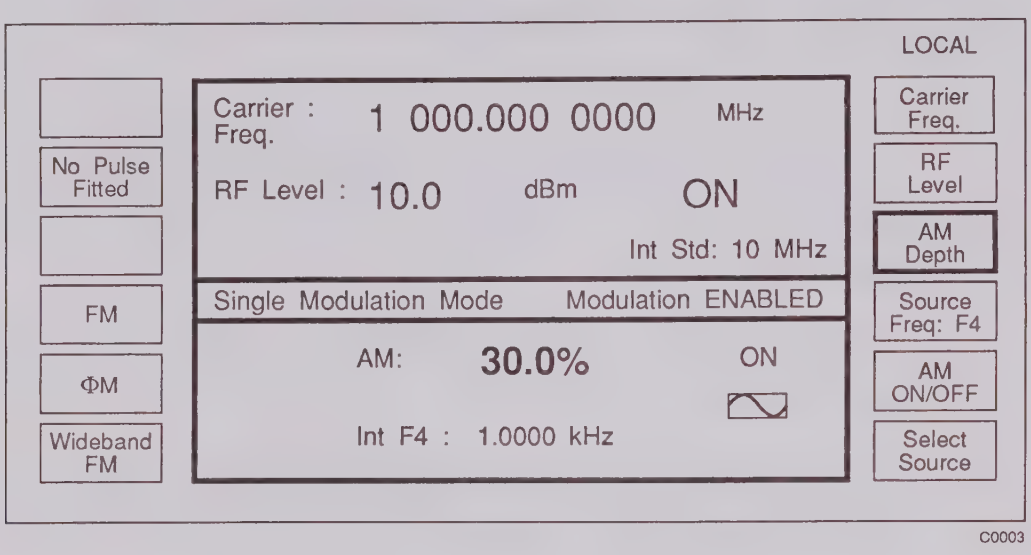


Fig. 3-1-5 Amplitude modulation - menu configuration

Using the [⇑ ×10] and [⇓ ÷10] keys

When a parameter has been selected via the numerical key pad, its value can be incremented or decremented either in steps using the [⇑] key and the [⇓] key, or continously with the control knob. Select *[Carrier Freq.]* and observe that the effect of pressing the [⇑] and [⇓] keys is to change the carrier frequency in steps of 1 kHz. Default step sizes are assigned to all parameters but these can be changed, see Page 3-1-25, 'INCREMENTING (using the delta function)'.

Using the control knob

(1) Press [KNOB UP/DN] to enable the control knob.

(2) On the display, brackets will appear above and below the selected parameter. These brackets embrace the part of the value which the control knob can change. Pressing the [×10] key shortens the bracket length by one decimal place. Pressing the [÷10] key increases the bracket length by one decimal place. In this way the sensitivity of the control knob can be increased or decreased by a factor of ten.

(3) Rotate the control knob and observe the change in the selected parameter. Press [KNOB UP/DN] to disable the knob.

(4) For other parameters, press the relevant soft key and use the [⇑] and [⇓] keys or the control knob.

Note...

For *RF Level* the knob resolution is fixed at 0.1 dB.

DETAILED OPERATION

CARRIER FREQUENCY

The carrier frequency is selected from the main menu by pressing *[Carrier Freq]*, unless it is already highlighted as in the default display.

Enter the required value via the numerical key pad. The value can then be incremented or decremented using the control knob and its associated keys, [KNOB UP/DN], [×10] and [÷10].

If a value outside the specified range is requested, the message:

ERROR 51: Carrier Outside Limits

is displayed on the screen when the terminator key is pressed, and the instrument is automatically set to the end of the range.

Carrier ON/OFF

The carrier may be switched *ON* or *OFF* at any time via the [CARR ON-OFF] key. This effectively switches the output ON and OFF, retaining the 50 Ω output impedance.

OUTPUT LEVEL

The output level is selected at the Sig Gen menu by pressing *[RF Level]* and entering the required value on the numerical key pad. If a value outside the specified range is requested the message:

ERROR 52: RF Level Outside Limits
or
ERROR 17: RF Level limited by AM

is displayed and the instrument is automatically set to the end of the range.

Choice of units

Units may be μV, mV, V or dB. Conversion between dB and the voltage units is carried out by pressing the appropriate units key, i.e. to change dBm to a voltage unit, press any voltage key for the correct conversion. The choice of Volts EMF, Volts PD, and the dB reference is made by using the *[RF Level Units]* utility, see Page 3-1-37, 'RF Level units'.

Reverse power protection

Accidental application of power to the RF OUTPUT socket trips the reverse power protection circuit (RPP) and a flashing message appears on the display, see Fig. 3-1-6.

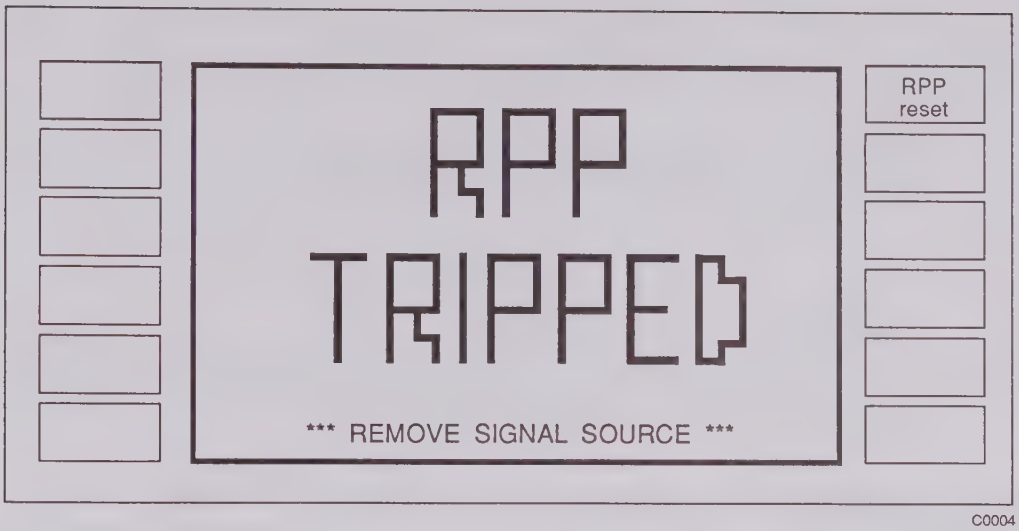


Fig. 3-1-6 RPP Tripped

Pressing *[Reset]* resets the RPP and returns the display to the menu in use when the reverse power protection was tripped. If *[Reset]* is pressed with the signal still applied, the RPP will trip again.

MODULATION

The carrier can be frequency, amplitude, or phase modulated, with pulse modulation as an option. The internal modulation oscillator has a frequency range of 0.1 Hz to 500 kHz, with a resolution of 0.1 Hz.

Selecting the modulation

The type of modulation required, AM, FM, ΦM, wideband and optional pulse modulation can be selected by soft keys at the main menu. Four modulation modes are available, see Page 3-1-17, 'Modulation mode selection'.

Modulation ON/OFF

[MOD ON-OFF] switches all modulation *ON* or *OFF* and the condition is indicated in the centre of the main display, e.g:

Modulation DISABLED

Modulation is also controlled by a soft key which turns the selected modulation on and off. For modulation to appear on the carrier, modulation must be both enabled with the [MOD ON-OFF] hard key and turned on via the soft key. In single modulation modes the [MOD ON-OFF] key and the *[FM ON/OFF]*, *[AM ON/OFF]*, *[ΦM ON/OFF]* keys appear to carry out the same function, but the action is different, particularly in the FM mode. The *[FM ON/OFF]* etc. soft keys only reduce the modulation to zero whereas the [MOD ON-OFF] key completely disables the modulation system such that the instrument reverts to a carrier frequency generator.

Selecting amplitude modulation

(1) At the Sig Gen menu, press *[AM]*, the *[AM Depth]* box is now highlighted.

(2) Enter the required modulation depth via the numerical key pad and terminate with the [%] key. If the modulation depth requested exceeds 99.9%, the depth is reset to the maximum value available and the message:

ERROR 56: AM Outside Limits

is displayed at the top of the screen.

(3) Switch the AM ON or OFF by pressing *[AM ON/OFF]*. The AM information is displayed in the lower half of the screen.

Selecting frequency modulation

(1) At the Sig Gen menu, press *[FM]*, the *[FM Devn.]* box will be highlighted.

(2) Enter the FM deviation value via the numerical key pad and terminate it with [Hz], [kHz] or [MHz].

(3) Switch the FM ON or OFF via *[FM ON/OFF]*. The FM information is displayed in the lower half of the screen.

Selecting phase modulation

(1) At the Sig Gen menu, press *[ΦM]*. The *[ΦM Devn.]* box will be highlighted.

(2) Enter the phase modulation deviation value via the numeric key pad and terminate it with the [RAD] key.

(3) Switch the ΦM ON or OFF via the *[ΦM ON/OFF]* key. The ΦM information is displayed in the lower half of the screen.

Selecting wideband frequency modulation

(1) At the Sig Gen menu, press *[Wideband FM]*. The *[Wideband FM]* box will be highlighted.

(2) The value can be changed via the key pad and frequency terminator key. To preserve the widest bandwidth, the control of the wideband FM is carried out in a series of fixed steps and the signal generator automatically displays the calculated fixed step which is closest to the keyed in value. Applying a 1 V RMS sine wave to the rear panel WIDE BAND FM IN socket will produce the indicated deviation.

(3) Pressing *[AC/DC Coupling]* changes the coupling from AC to DC and vice versa. When the input is DC coupled, small frequency offsets can be reduced by using the nulling facility. Nulling can be effected by pressing *[DCFM Nulling]*. The legend:

**** DCFM NULLING ****

appears briefly on the display.

Note...

The [⇑] and [⇓] keys and the control knob do not operate for wideband FM.

CAUTION

The WBFM socket is always terminated in 50 Ω. The DC component of of any applied voltage must not exceed 5 V.

Modulation source frequency

(1) At the Sig Gen menu press *[Source Freq.]*.

(2) Enter the required source frequency and terminate the entry with [Hz], [kHz] or [MHz].

Note...

When the modulation source is operating as a continuous signalling tone the *[Source Freq.]* legend is replaced with the *[Tone Number]*. Pressing the key allows a new tone number to be entered.

Source selection - internal

The modulation source may be selected by pressing *[Select Source]*. Sources may be internal or external. If the currently selected source is internal, the *Internal Source Selection Menu* is displayed, giving a choice of six frequencies, F1-F6, see Fig. 3-1-7. The frequency assigned to the highlighted F number may be changed by the numerical key pad and terminated with [Hz], [kHz], [MHz] or [GHz]. Soft keys allow the selection of either a sine or triangular waveform. The selection of sub-audible continuous tones can be achieved by pressing *[CTCSS]*, see 'SIGNALLING'. Pressing *[Mod. Src Phase]* displays the *LF Source Phase Control* menu, see Fig. 3-1-8. The LF source phase angle can be varied from -180° to +180°. The pictograms at the end of each line show a symbolic sine wave when a source is selected. This changes to a triangular wave if *[Triangle Wave]* is selected. These symbols also appear on the main menu. A horizontal bar is shown when a source is not selected or is not available.

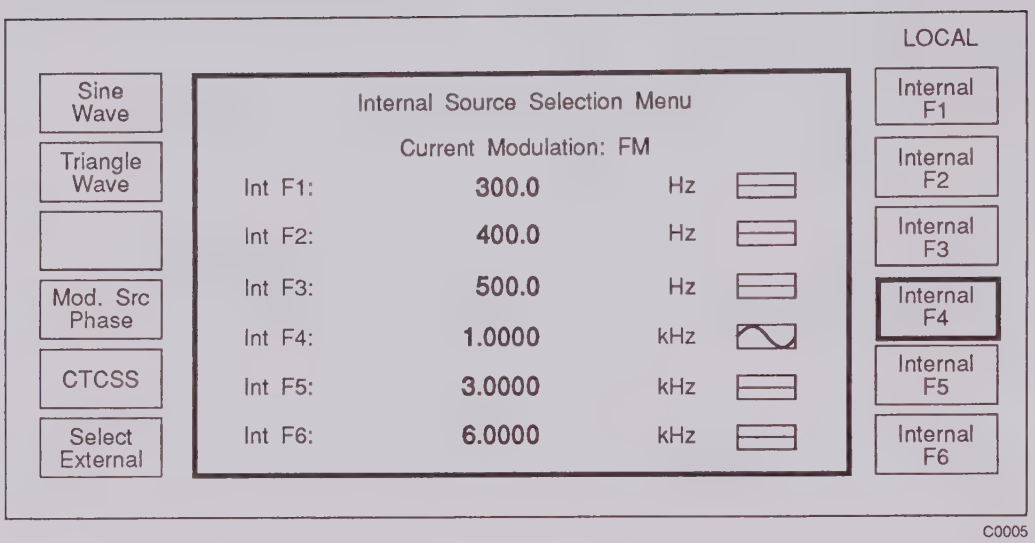


Fig. 3-1-7 Internal source selection menu

LF phase

When an internal source has been selected, its phase relative to the second modulation oscillator (if fitted) can be changed by pressing *[Mod. Src Phase]* and entering the required value. Where two internal modulation frequencies are active, the starting phase difference between the two signals can be set up and the phase angle is referred to the currently selected oscillator.

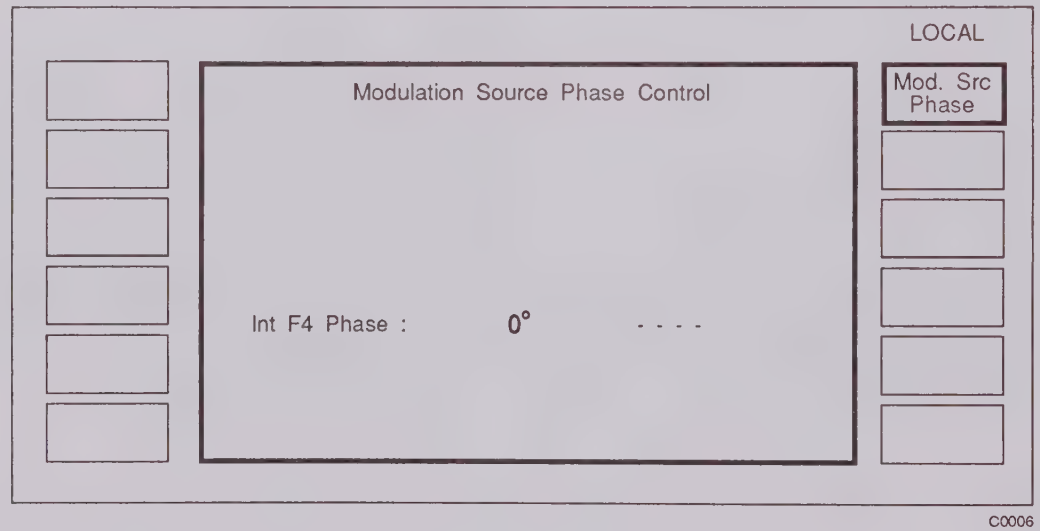


Fig. 3-1-8 LF phase control

Source selection - external

An external source may be selected by pressing *[Select External]*. The *External Source Selection Menu* is then displayed on the screen (This menu is displayed immediately when pressing *[Select Source]* if the currently selected source is external). This menu allows the choice of two input sockets Ext Mod 1 and Ext Mod 2 and AC, ALC, or DC coupling by pressing the appropriate soft key. The pictograms at the end of each line show a symbolic arbitrary waveform when an external source is selected. This symbol also appears on the main menu. A horizontal bar is shown when a source is not selected or is not available. When the input is DC coupled, small frequency offsets can be reduced by using the nulling facility. Nulling can be effected by pressing *[DCFM Nulling]*.

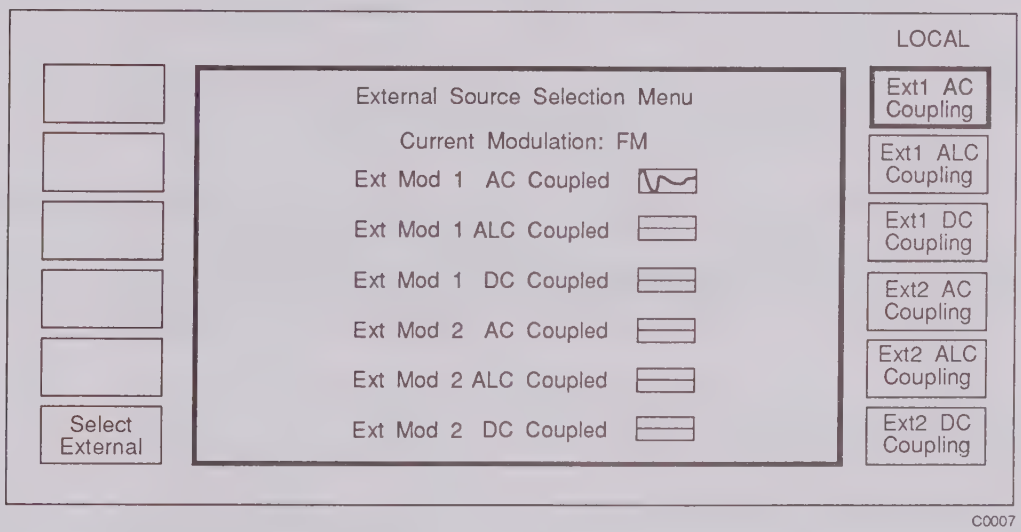


Fig. 3-1-9 External source selection menu

Selecting pulse modulation (applies if Option 002 is fitted)

(1) At the Sig Gen menu, press *[Pulse Mod]*, when the Pulse Mod box on the display will be highlighted.

(2) Selecting and Enabling Pulse Mod changes the RF level control loop to the Direct Level Control mode, which can take up to 100 ms to action. For best accuracy, this process should be repeated before measurements are taken if neither the Carrier Frequency or RF Level have been changed recently. When Pulse Mod is disabled the RF Level is controlled in the normal way.

(3) Switch Pulse Mod on or off with the *[Pulse On/Off]* key. When 'On', the carrier is controlled by the logic level applied to the Pulse Input socket mounted on the front panel. A logical '1' (a voltage between 3.5 and 5 V) allows Carrier Output, a logical '0' (a voltage between 0 and 1.0 V) suppresses it. Turning Pulse Mod off effectively applies a logical '1' allowing Carrier Output.

MODULATION ALC

The automatic levelling control (ALC) is used in conjunction with an external source and can be disabled when not required. To enable the ALC, proceed as follows:

(1) At the Sig Gen menu, press *[Select Source]*. The display will show the *Internal or External Source Selection Menu* (Fig. 3-1-7 or Fig. 3-1-9).

(2) If necessary press *[Select External]* to obtain the *External Source Selection Menu* (Fig. 3-1-9).

(3) Select the required external source from the options shown, e.g. *[Ext 1 ALC Coupling]* or *[Ext 2 ALC Coupling]*. The pictogram at the end of each line will change from a horizontal line to an arbitrary waveform symbol when the source is selected.

(4) Return to the Sig Gen menu by pressing [SIG GEN]. The legend *Ext Mod 1 (or 2) ALC coupled* appears at the bottom of the display.

(5) Apply a signal to the [EXT MOD 1] or [EXT MOD 2] input socket and vary the level. If the input applied to the external modulation socket outside the ALC range (at least 0.7 to 1.4 V RMS) *HI LO* will be indicated and an error message will be displayed at the top of the screen. If the level is within the required range, the arbitrary waveform symbol will appear alongside the modulation value.

MODULATION MODES

Two independent inputs on the front panel allow external modulation signals to be summed with signals from the internal oscillator and a second optional internal oscillator (if fitted). Thus up to four modulations may be available at one time. These can be combined to give single, dual, composite and dual composite modes.

Single

In the single mode, only one modulation can be active at any one time, and selecting another modulation cancels the first.

Dual

In the dual mode, a common carrier wave is modulated by two different types of modulation, e.g. one AM and one FM. Each type of modulation carries separate information.

Composite

This mode consists of two modulating channels with similar types of modulation, the effective modulation being the sum of the two waveforms e.g. FM1 + FM2. This mode cannot be used for pulse or wideband modulation.

Dual composite

This mode is similar to single composite with each of the two modulating channels being the sum of two sources, e.g. FM1 + FM2 and AM1 + AM2.

Modulation mode selection

In order to select a different modulation mode;

(1) Press [UTIL]. *Utilities Selection Menu 1* will appear on the display.

(2) Press *[Mod'n Mode]*. The display changes to show the four options. Press the required soft key.

(3) Press [SIG GEN] to return to the Sig Gen menu where the modulation mode and individual source parameters will be shown.

Selecting the required mode channel

(1) Select the required mode channel by pressing the relevant soft key, e.g. *[FM1]* or *[FM2]*. The box containing the parameters for the selected channel is now highlighted, see Fig. 3-1-10.

(2) At this point, the modulation frequency, deviation or depth can be altered. The source frequency can also be changed by pressing *[Source Freq:Fn]* and entering the value in the usual way.

(3) The source can be changed from internal to external or vice versa by pressing *[Select Source]* for the relevant source selection menu.

(4) When an internal source has been selected, its phase can be changed by pressing *[Mod. Src Phase]* and entering the required value. Where two internal modulation frequencies are active, the starting phase difference between the two signals can be set up and the phase angle is referred to the currently selected oscillator.

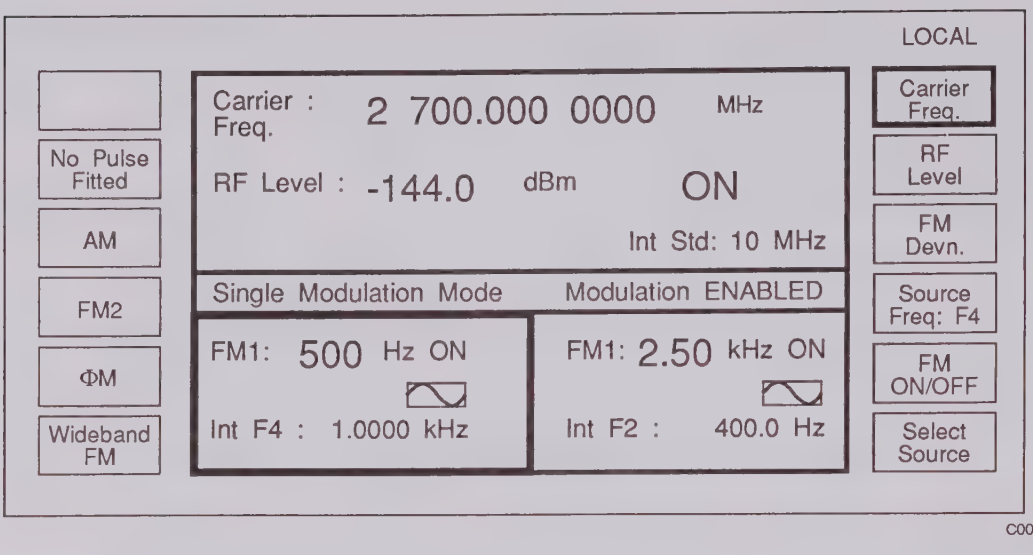


Fig. 3-1-10 Sig Gen menu with two modulation channels

Note...

Full information on the range of utilities can be found under 'UTILITIES'.

CONTINUOUS TONE SIGNALLING (CTCSS)

A CTCSS tone is any one of 32 standard sub-audible tones ranging from 67 Hz to 250.3 Hz and would generally be used in conjunction with an audible modulation signal in a composite modulation mode. The procedure for initiating these tones is as follows:

Tone selection

(1) At the Sig Gen menu, press *[Select Source]*.

(2) At the *Internal Source Selection Menu*, press *[CTCSS]*. The *Continuous Tone Selection Menu* is now displayed, see Fig 3-1-11.

(3) Key in the required tone number (0 to 15) and press [enter].

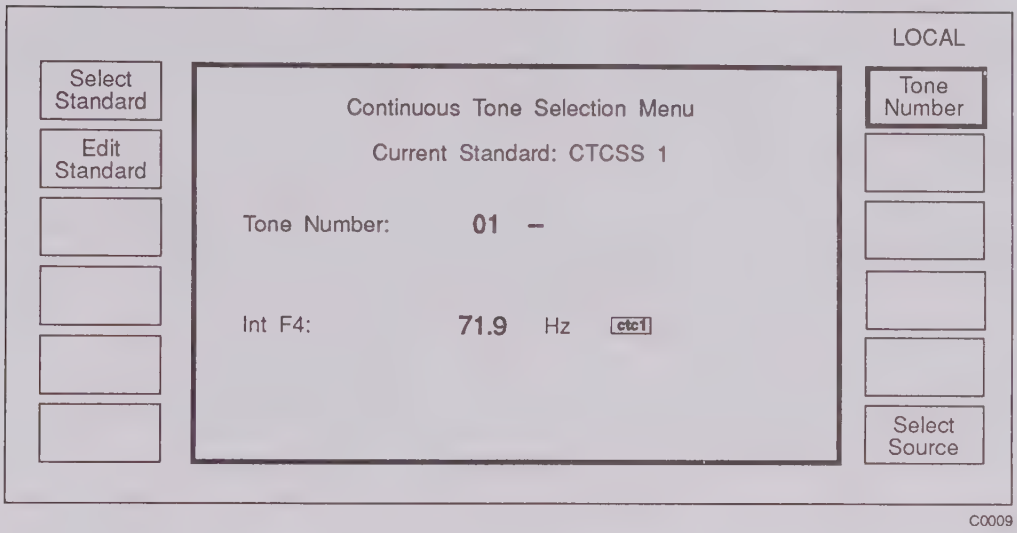


Fig. 3-1-11 Continuous tone selection menu

Selecting alternative tone standards

A list of the 16 tones of the current standard is available by pressing *[Select Standard]*. This action displays the *Tone Standard Selection Menu* with the current standard highlighted. To select from further lists of 16 tones, press *[CTCSS2]* or [USER]. The *Tone Standard Selection Menu* changes to show the new list.

Editing a tone standard

Pressing *[TEMP]* displays a further list of 16 tones set to the default value of 10 Hz. The standard can be edited by selecting *[Edit Standard]* from the menu in Fig. 3-1-11. This gives you the *Continuous Tone Edit Utility* menu.

CTCSS 1, CTCSS 2 or USER can be be loaded to TEMP, which is a volatile store of 16 tones set at a default value of 10 Hz at switch on. Tones can then be changed by using *[Tone No]*, *[Tone Freq]*, *[Next Tone]* or *[Previous Tone]*. When the required changes have been made, the new standard can be saved by pressing *[Store to User]*. *USER* then becomes a user defined standard.

Note...

Selecting *[CTCSS1]*, *[CTCSS2]*, *[USER]* or *[TEMP]* from the *Tone Standard Selection Menu* causes the pictogram in the *Continuous Tone Selection Menu* and the *Internal Source Selection Menu* to change e.g. *ctc1*. The pictogram is repeated in the modulation section of the Sig Gen menu.

SIGNALLING (Sequential Calling Tones)

There are eight sequential calling tone standards available, each having 16 set tones, see Tone Standard Selection Menu, Fig. 3-1-15. They are, CCIR, EURO, DZVEI, ZVEI1, ZVEI2, EEA, EIA and NATEL. There is also provision for the user to define sets of user tones in USER1 and USER2. DTMF signalling tones can also be generated if the second modulation oscillator (Option 001) is fitted.

Sequential calling tones are set up from a utility menu, Fig. 3-1-25, and are activated by pressing *[Send Tones]* which appears on the main menu after the tones have been set up. *[Send Tones]* also appears on the calling tones menu.

Tone selection

Pressing the *[Calling Tones]* soft key at *Utilities Selection Menu 1* calls up the *Sequential Calling Tones Utility* menu, see Fig. 3-1-12.

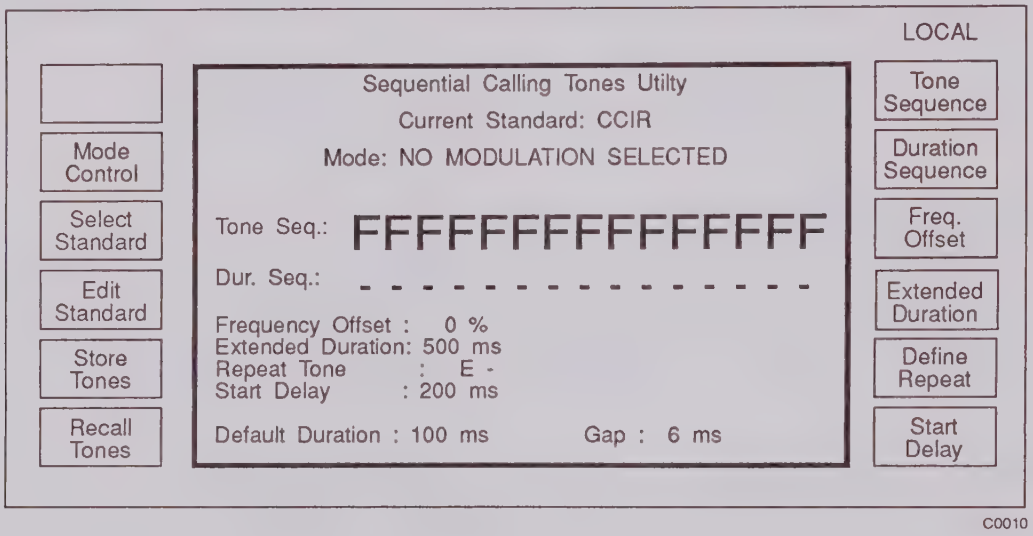


Fig. 3-1-12 Sequential calling tones utility menu

[Tone Sequence] Pressing this key causes hexadecimal data entry keys to appear at the right hand side of the menu. To change the sequence, enter the tone numbers via the digits 0-9 on the numerical keypad and the soft keys *[A]* to *[F]* and press [enter].

[Duration Sequence] Pressing this key causes *[Default Duration]* and *[Extended Duration]* to appear at the left hand side of the menu. Press either key in turn to set the duration of tones in the sequence. A dash (-) indicates the default duration and E indicates an extended duration. These two keys disappear when [enter] is pressed.

[Define Repeat] allows a repeat tone to be defined, by using the [A] to [F] keys and the keypad and pressing enter. For example, if the repeat tone is defined as tone C, the sequence 11111 will be sent as 1C1C1 so that the receiver decoders will sense a change in frequency at the start of each digit sent.

[Freq. Offset] This facility alters the nominal tone frequency by a set percentage (up to ±10%) for use in tolerance testing. To change the frequency offset value, select *[Freq. Offset]* and enter the new value on the key pad. Terminate with the [%] key.

[Store Tones] Up to 20 sequence set-ups can be stored. Use the keypad to enter the store location number and press [enter].

[Recall Tones] To recall a tone sequence, use the key pad to select the required store location and press [enter].

[Start Delay] The delay before the tone sequence starts and the gap between sequences can be adjusted by pressing this soft key, entering the required delay time on the keypad and pressing [ms].

[Mode Control] Pressing this enables the user to assign the calling tones to a selected type of modulation, see Fig. 3-1-14. Modulation, on the selected channel, is turned off when the tones are triggered and restored after the tones have been sent. Modulation on other channels is not affected by the calling tones and this allows sequential signalling tones to be combined with sub-audible tones. *[NO mod]* This option effectively inhibits sequential tones. The tone sequence can be sent between 1 and 9 times, set by *[No. of Repeats]*, every time the *[Send Tones]* key is pressed. Setting the number of repeats to 10 allows the tones to be sent continually under control of the *[Send Tones]*/*[Stop Tones]* key at the main menu.

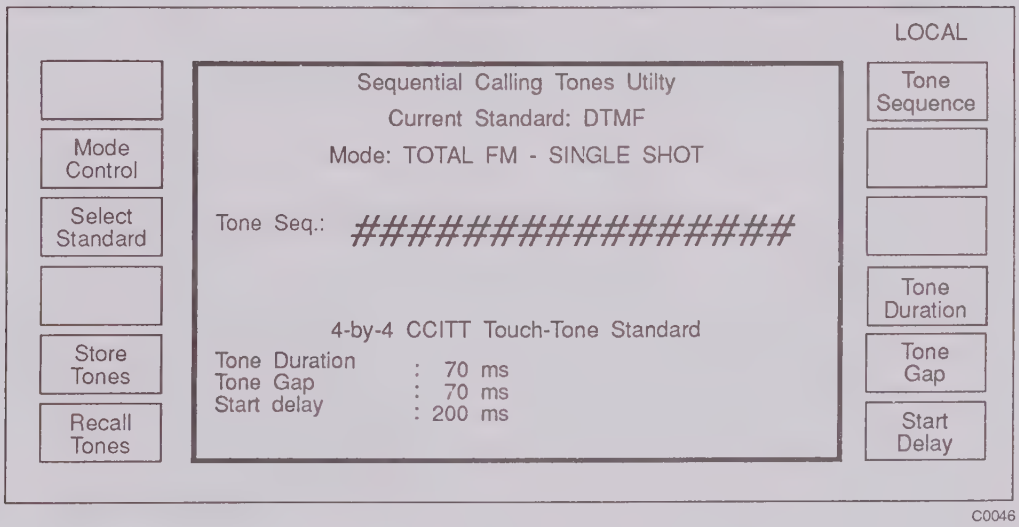


Fig. 3-1-13 Sequential calling tones utility menu (DTMF mode)

On 2030 series fitted with the second modulation oscillator (Option 001) the DTMF signalling capability is also provided. If this standard is selected then the main menu accessed after pressing *the [Calling Tones]* soft key at *Utilities Selection Menu 1* will be as shown in Fig. 3-1-13. The functions of the soft keys are as follows:

[Tone Sequence] Pressing this key allows a tone sequence to be set up using the digits 0-9 on the numerical keypad and the soft keys *[A]*, *[B]*, *[C]*, *[D]*, *[*]* and *[#]*. The sequence entry is terminated by pressing [enter].

[Tone Duration] The default duration of 70 ms for each tone in the sequence can be changed by pressing this key, entering the required duration value and pressing [ms].

[Tone Gap] The default gap duration of 70 ms between each tone in the sequence can be changed by pressing this key, entering the required gap length and pressing [ms].

[Start Delay] The delay before the tone sequence starts and the gap between sequences can be adjusted by pressing this soft key, entering the required delay time on the keypad and pressing [ms].

[Mode Control] Pressing this enables the user to assign the calling tones to a selected type of modulation, see Fig. 3-1-14. Modulation, on the selected channel, is turned off when the tones are triggered and restored after the tones have been sent. Modulation on other channels is not affected by the calling tones and this allows sequential signalling tones to be combined with sub-audible tones. *[NO mod]* This option effectively inhibits sequential tones. The tone sequence can be sent between 1 and 9 times, set by *[No. of Repeats]*, every time the *[Send Tones]* key is pressed. Setting the number of repeats to 10 allows the tones to be sent continually under control of the *[Send Tones]*/*[Stop Tones]* key at the main menu.

[Select Standard] Selection of alternative signalling standards is achieved by pressing this key to access the *Select Standard Menu.*

[Store Tones] Up to 20 sequence set-ups can be stored. Use the keypad to enter the store location number and press [enter].

[Recall Tones] To recall a tone sequence, use the key pad to select the required store location and press [enter].

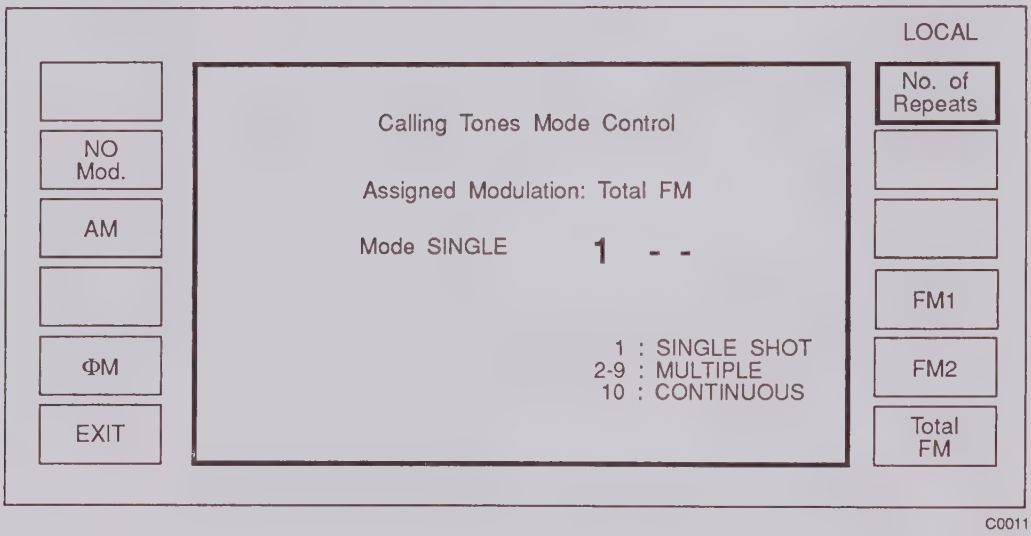


Fig. 3-1-14 Calling tones mode control menu (with [FM] selected)

Selecting alternative tone standards

The *[Select Standard]* key causes the *Tone Standard Selection Menu* to be displayed, see Fig. 3-1-15

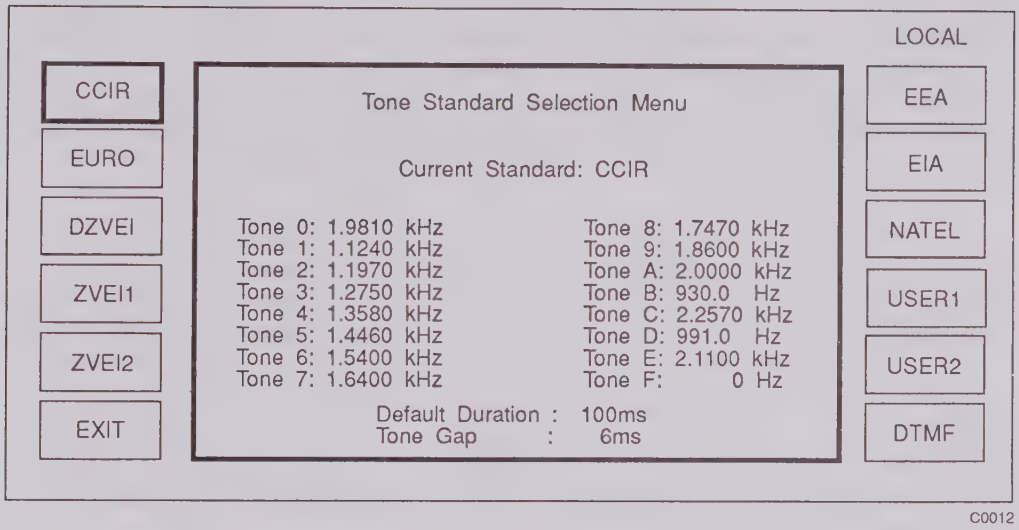


Fig. 3-1-15 Tone standard selection menu

The tone sequential standard to be used is selected by pressing the appropriate soft key. This menu also shows the frequency and timing characteristics for each tone in the standard. User 1 and User 2 are user defined tone standards stored in non-volatile memory. The *[DTMF]* soft key only appears on the display if the instrument is fitted with a second modulation oscillator (Option 001 fitted). If only a single oscillator is fitted the *[DTMF]* key is left blank

Editing a tone standard

Pressing the *[Edit Standard]* key when in the *Sequential Calling Tones Utility* menu (Fig 3-1-12) will produce the *Edit Sequential Tones* Utility, see Fig. 3-1-16, which allows a user defined tone system to be set up.

All editing is carried out in a tone standard called TEMP which is not stored beyond switch off. To ensure that the alterations are available for future use the newly defined tone standard must be saved to non-volatile storage in either USER1 or USER2.

The editing facility allows the user to define the frequency of each of the 16 tones in the system and to set the default duration of each tone in the sequence and the gap between tones (if any). All other settings are handled in the normal *Sequential Tones Utility* menu.

The currently selected tone standard may be copied into the TEMP working space using the top left soft key (shown *[CCIR to TEMP]* in Fig. 3-1-16) and often this is a convenient way to start, particularly when the user defined system is similar to one of the standard systems.

To edit the system in TEMP use *[Tone Number]* to select the number of the tone to be edited (0 to 15) and after pressing *[Tone Freq.]* enter the new frequency to be assigned to this tone number. Select other tones in the system by means to the *[Tone Number]* key or use the *[Next Tone]* and *[Previous Tone]* keys to step through the list. Enter the frequencies of the tones and then use *[Default Duration]* and *[Tone Gap]* to set the times in milliseconds for the default duration of each tone and the gap between each tone.

Finally store the user defined tone system parameters in USER1 or USER2 by pressing *[Store to USER1]* or *[Store to User2]*.

Note that when using the DTMF tone signalling capability no editing facility is provided. Changes to the default settings are made directly on the *Calling Tones Utility Menu.*

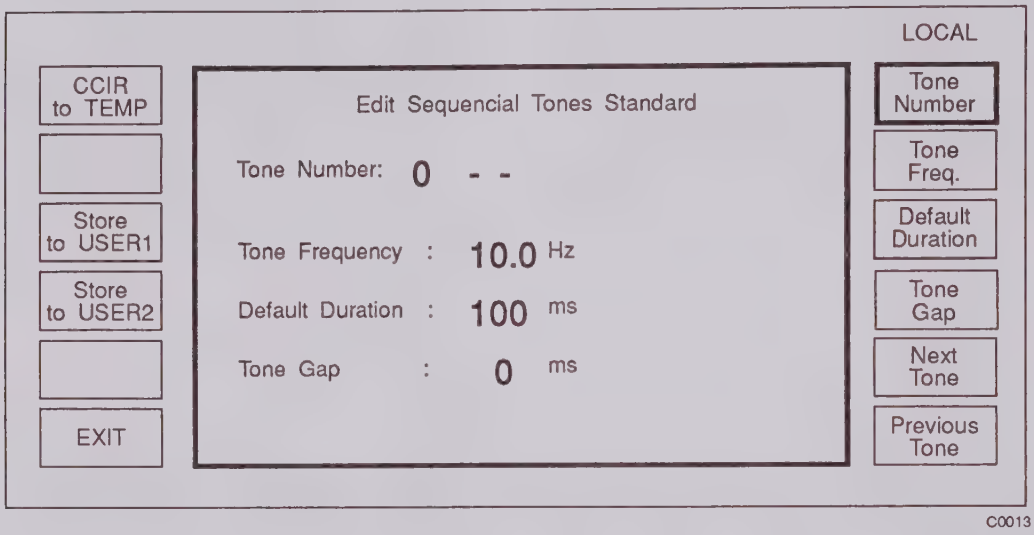


Fig. 3-1-16 Edit sequential tones standard menu

INCREMENTING (using Δ)

Displaying shifts

Press the [Δ] hard key. The total shift menu is displayed as shown in Fig. 3-1-17. This menu displays the difference between the current value and the keyed-in value. Parameters can be incremented or decremented by using the [⇑] or [⇓] key or the control knob, see 'Using the control knob' on Page 3-1-8. To cancel any changes made by the rotary control or the ⇑/⇓ keys, press *[Return Value]*. This will restore the setting of the selected parameter to the keyed-in value, i.e. the indicated shift will return to zero. Pressing *[Transfer Value]* transfers the current value to the Sig Gen menu as the keyed in value.

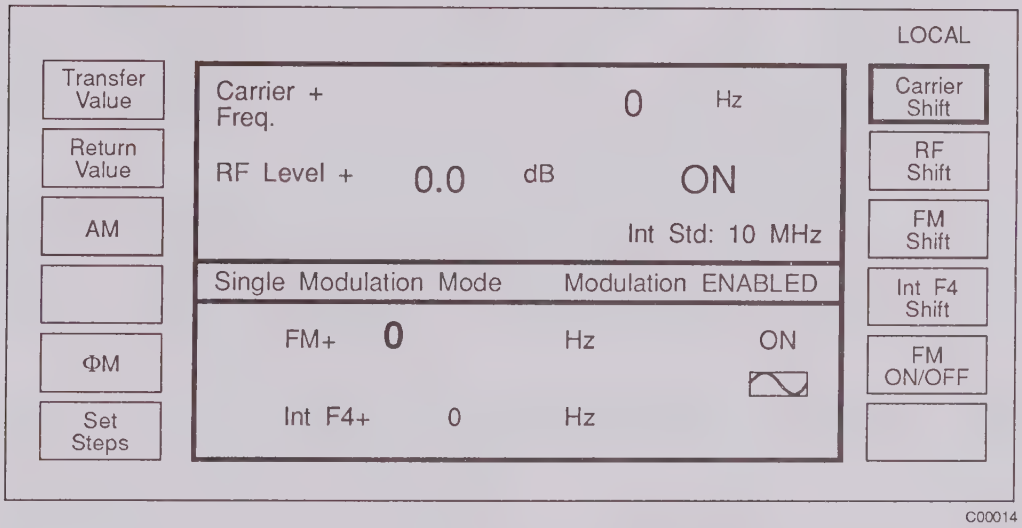


Fig. 3-1-17 Total shift menu

Setting increment values

(1) From the total shift menu select *[Set Steps]*. The screen shows the currently set step sizes.

(2) Select *[Carrier Step]*, enter the value on the key pad and press a terminator key. The step value will appear on the screen.

(3) Return to the main menu by pressing [SIG GEN].

(4) Using the ⇑/⇓ keys respectively will now increment or decrement the carrier frequency by the set value.

(5) *[RF Level Step]*, *[AM step]* and *[Source Step]* values can be entered in the same way.

Note...

Wideband FM and Pulse modulation parameters cannot be incremented in this manner.

SWEEP

The sweep capability allows the comprehensive testing of systems, as measurements at single points will not necessarily give an overall indication of the performance. The sweep function is specified by the following parameters:

- Start value
- Stop value
- Number of steps
- Time per step

Up to five individually adjustable markers may be set. Each marker can be turned on and off separately. Sweep functions available are:

- Carrier frequency with or without modulation
- RF Level
- Internal modulation rate
- LF frequency (if in LF generator mode)
- LF level (if in LF generator mode.

The sweep can be operated in single shot or continuous modes with the start command triggered by a key press, an external pulse or GPIB control. Once started, the sweep can be stopped at any time when the display will indicate the current parameter value. The sweep can be used with oscilloscopes, X-Y display units and X-Y plotters by connecting the display unit X input to the SWEEP RAMP output on the rear panel.

A sweep routine is set up as described in the following paragraphs:

Sweep type

(1) Press the [SWEEP] hard key. The sweep parameters display, with soft key options, appears on the screen, see Fig. 3-1-18.

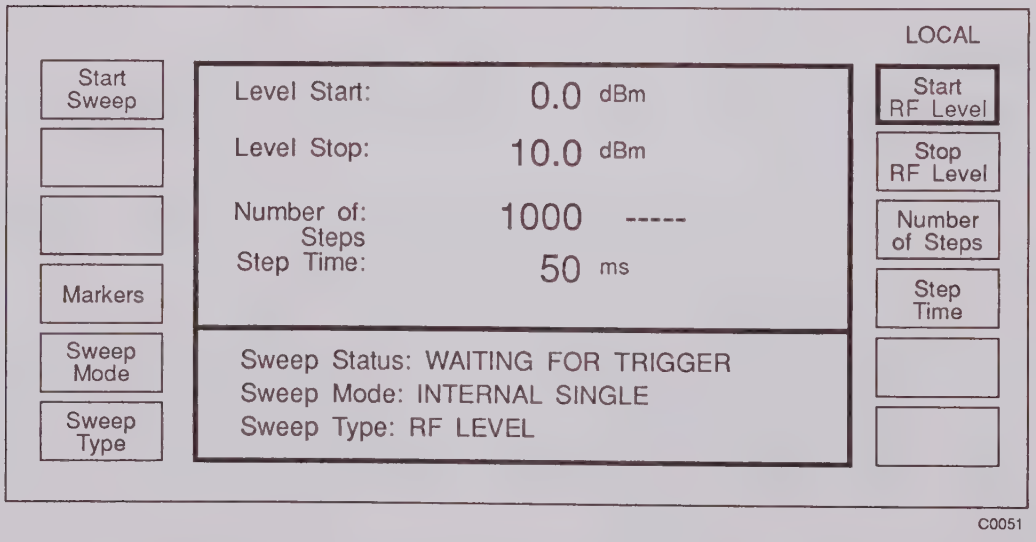


Fig. 3-1-18 Sweep parameters display

(2) Press *[Sweep Type]*. The *Sweep Type Menu* is displayed, see Fig. 3-1-19.

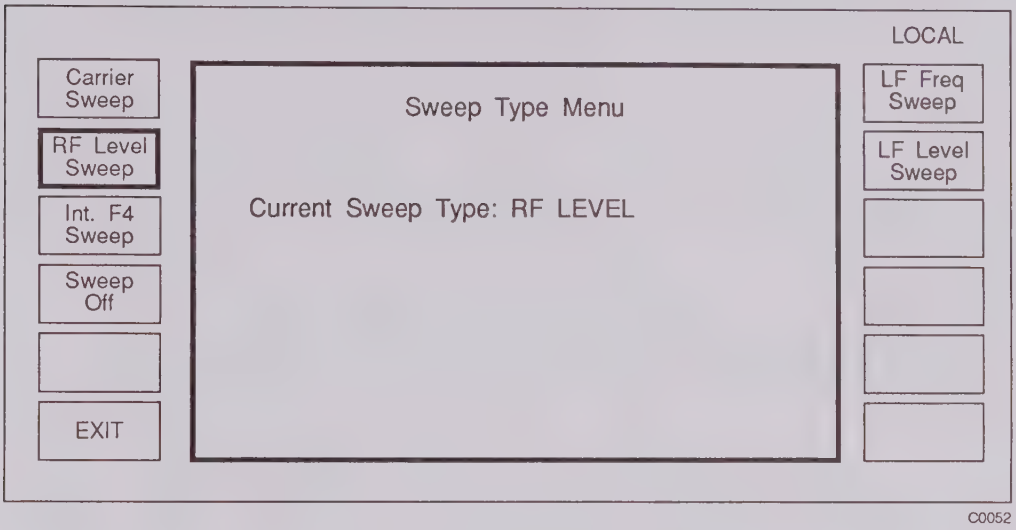


Fig. 3-1-19 Sweep type menu

The instrument must be in the LF generator mode before an LF frequency sweep and LF level sweep can be initiated.

Modulation required during sweep should be entered before putting the instrument in the sweep mode.

(3) Select the required sweep type by pressing the appropriate soft key, e.g. *[Carrier Sweep]*. The Sweep Type screen changes to confirm the selection.

(4) Press [*EXIT*] or [SWEEP] to return to the sweep parameters display.

Sweep mode

(1) At the sweep parameters menu, press *[Sweep Mode]*. The *Sweep Trigger Mode Menu* is displayed, see Fig. 3-1-20.

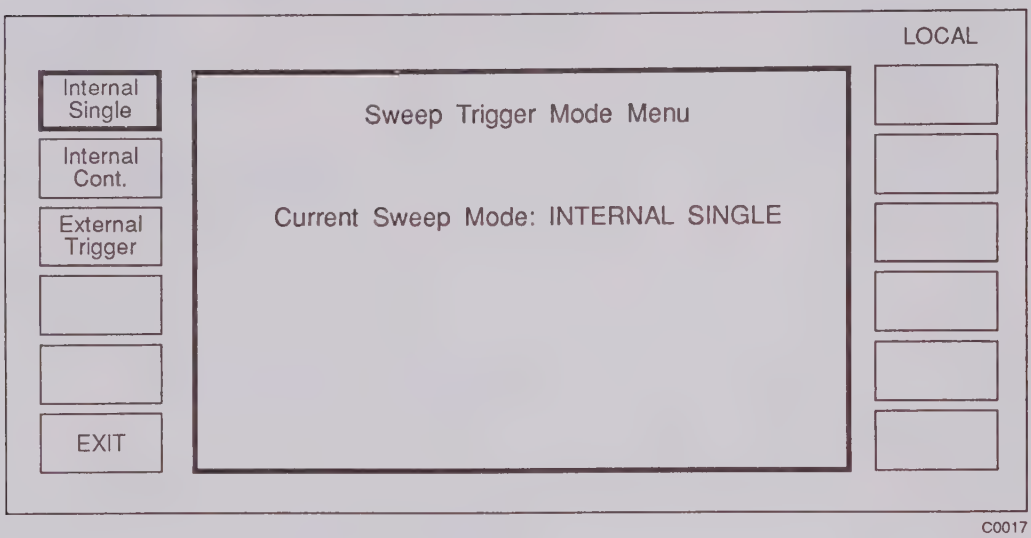


Fig. 3-1-20 Sweep trigger mode menu

(2) Select the sweep mode, *[Internal Single]*, *[Internal Cont.]*, or *[External Trigger]*.

(3) Press *[EXIT]* to return to the sweep parameters display menu.

(4) If *[External trigger]* is selected, press [UTIL], select *[Utils. Menu 1]* and from this menu press *[External Trigger]*. The *External Trigger Selection Menu* will be displayed. Then press [SWEEP] to return to the Sweep Parameters display.

Start value

(1) Select the appropriate soft key to enter the start value, e.g. *[Start Freq]*.

(2) Enter the required start value via the numerical key pad and the appropriate terminator key.

Stop value

(1) Select the appropriate soft key to enter the stop value, e.g. *[Stop Freq]*.

(2) Enter the required stop value via the numerical key pad and the appropriate terminator key.

When carrier frequency parameters are entered, the instrument calculates all the individual step values together with any level and modulation correction factors. While this process is taking place, the sweep status line changes to indicate '*CALCULATING SWEEP*'.

Number of steps

(1) Select *[Number of Steps]*.

(2) Enter the number of steps via the numerical key pad and the [GHz/V/enter] terminator key.

Note...

If an inappropriate number of steps is selected, the instrument will automatically choose a more reasonable value. The number of steps available depends on the operating mode and the maximum values are:

250	for carrier frequency with FM, ΦM or Wideband FM enabled
1,000	for carrier frequency without FM, ΦM or Wideband FM enabled.
10,000	for RF level, RF modulation frequency, LF frequency and LF level.

Step time

(1) Select *[Step Time]*.

(2) Enter the step time via the numerical key pad and the [MHz/mV/ms] terminator key.

Markers

A facility exists for producing markers, controlled by the Markers Menu, see Fig. 3-1-21.

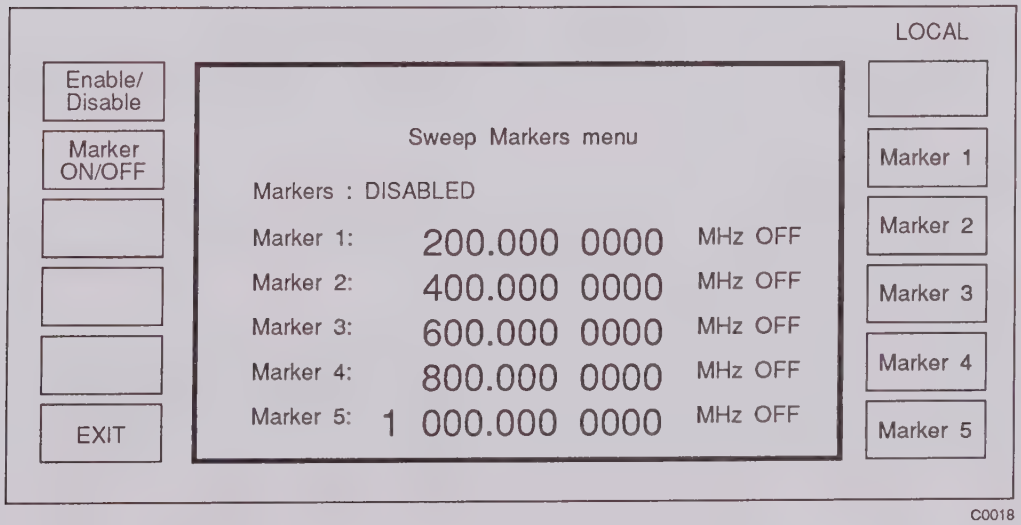


Fig. 3-1-21 Markers Menu

To set a marker, press one of the marker soft keys e.g. *[Marker 3]*, enter the required value on the key pad and terminate with the appropriate units hard key. Turn the marker ON using the *[Marker ON/OFF]* key. When all markers have been entered use the *[Enable/Disable]* key to activate the marker output on the rear panel. The marker output produces a positive going pulse with a duration of one sweep step when the sweep passes a marker value.

Starting the sweep

From the sweep parameters menu, press *[Start Sweep]*. The single sweep status line display changes from *WAITING FOR TRIGGER* to *SWEEPING* and a solid bar increments to show the sweep progression, see Fig. 3-1-22.

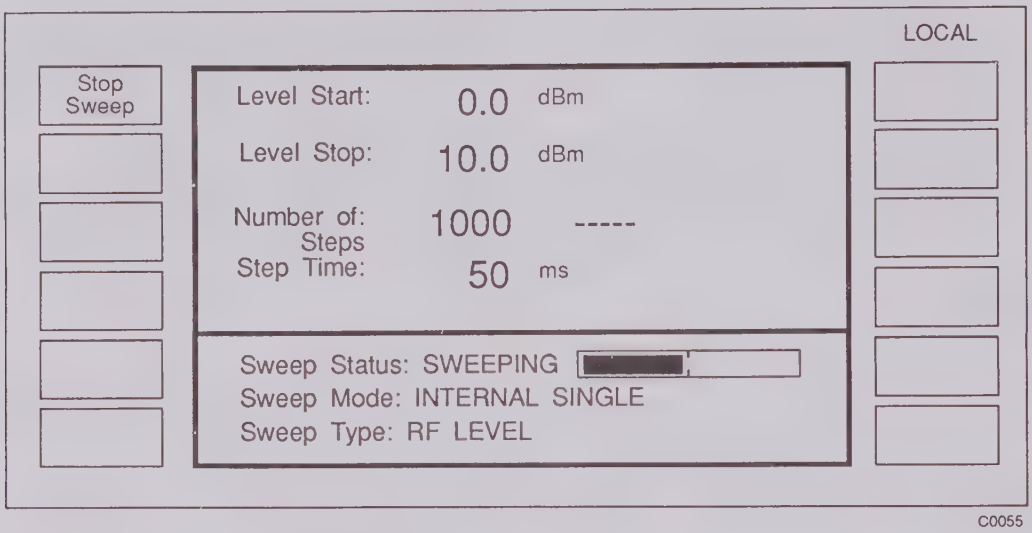


Fig. 3-1-22 Sweep in progress

Note ...

When the sweep is in progress, all the hard keys are disabled and *[Stop Sweep]* is the only active soft key.

Stopping the sweep

Press *[Stop Sweep]*. The sweep stops and the menu presents the opportunity to press:-
[Reset Sweep] to change the sweep parameters, or
[Continue Sweep] to continue the sweep, or
[Transfer] to transfer the current value of the swept parameter as the last keyed in value in the [SIG GEN] or [LF](*[LF Gen]*) mode, see Figs. 3-1-23 and 3-1-24. When the sweep is in the paused state, the ⇑ and ⇓ keys can be used to step the parameter up or down. The sweep can then be continued by pressing *[Continue Sweep]*.

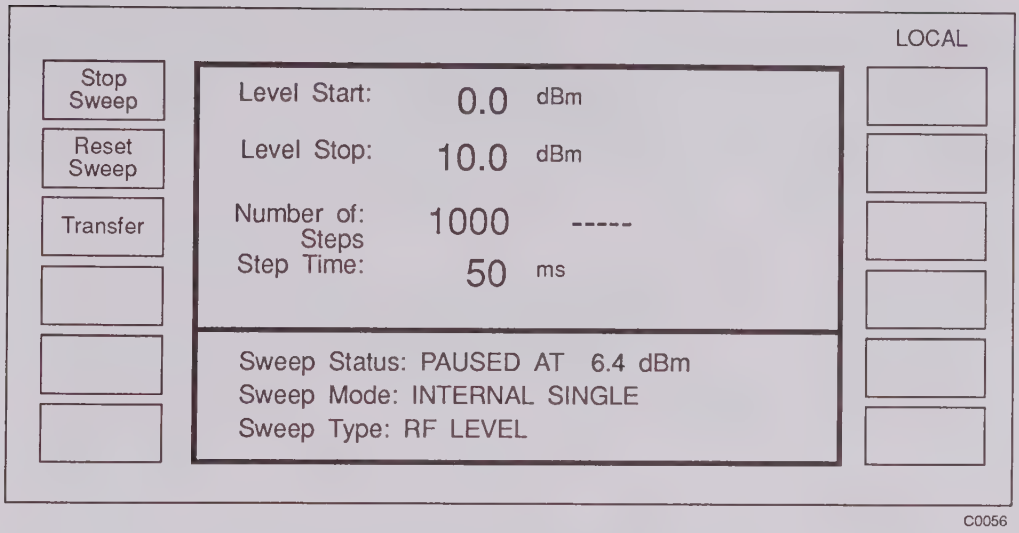


Fig. 3-1-23 Sweep stopped

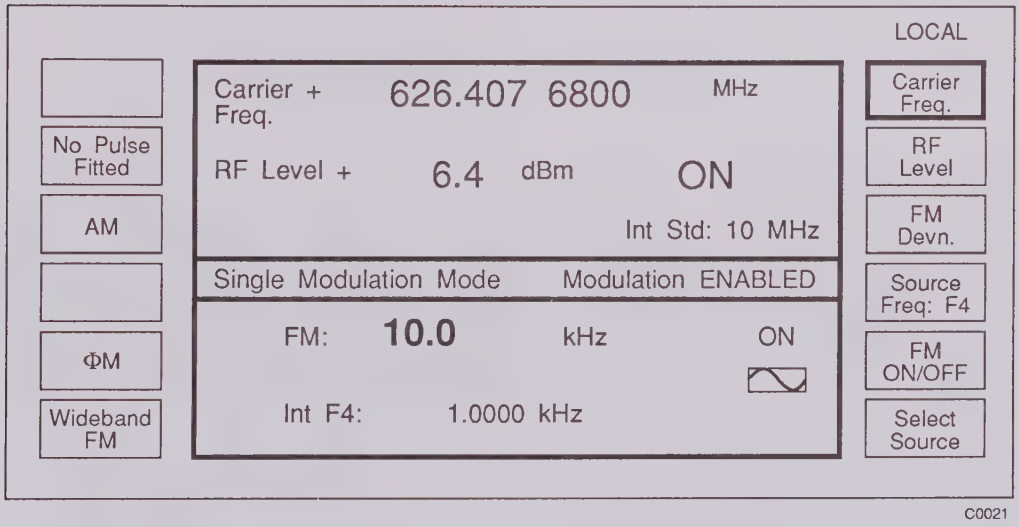


Fig. 3-1-24 RF level transferred

UTILITIES

The utilities options are accessed from two primary menus. Pressing the [UTIL] hard key from any menu causes the *Utilities Selection Menu 1* to appear on the display, see Fig. 3-1-25, unless the user is in a sub-menu of *Utilities Selection Menu 2*, in which case pressing [UTIL] will cause *Utilities Selection Menu 2* to be displayed, see Fig. 3-1-27. To obtain *Utilities Selection Menu 2* from *Utilities Selection Menu 1*, press *[Utils Menu 2]*. To return to a main menu from any level in the utilities hierarchy, press one of the hard keys.

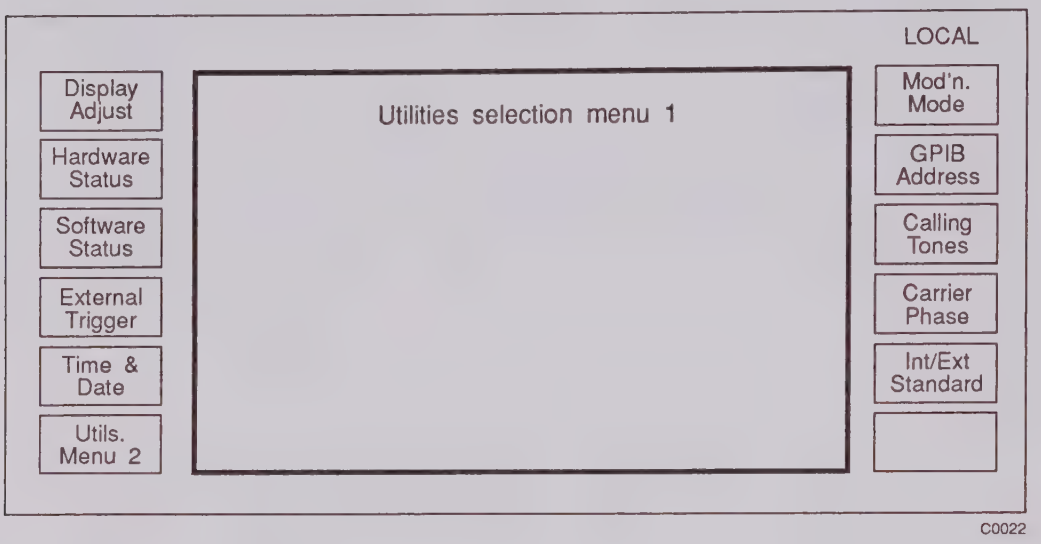


Fig. 3-1-25 Utilities selection menu 1

Adjusting the display

To adjust the display, press *[Display Adjust]*. The *Display Adjust* menu is displayed on the screen, see Fig. 3-1-26. The backlight, which is on when the instrument is switched ON, can be toggled ON or OFF using the *[Display On/Off]* key, and when ON can be varied in brightness by *[Dim]*, *[Medium 1]*, *[Medium 2]* and *[Bright]*. Contrast is adjusted with the control knob. Once adjusted, the LCD setting can be stored in the the non-volatile memory by pressing *[Save LCD setting]*. The instrument always activates the backlighting whenever it is switched on.

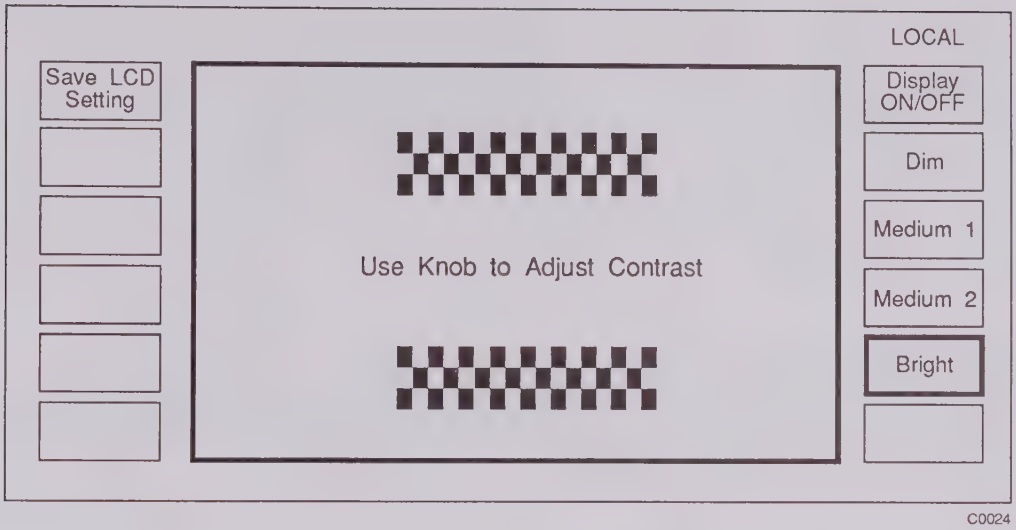


Fig. 3-1-26 Display adjust menu

Hardware information

To obtain a description of the instrument hardware, press *[Hardware Status]* and the following information is displayed:

Instrument type (e.g. *2031*)
Serial no. (e.g. *1543256/045*)
Options fitted (e.g. *SECOND LF OSC.*)
Attenuator type and serial number.

For attenuator calibration information, refer to the Service Manual.

Software information

To obtain a description of the instrument software, press *[Software Status]* and the following information is displayed:

Software Version Number e.g. *2.001*
Part number e.g. *44533-366*
GPIB address e.g. *07*

External trigger

To use the external trigger facility, press *[External Trigger]*. The display will change to show the External Trigger Selection Menu which has the following options for selecting the function of the SWEEP TRIGGER socket on the rear panel:

[Sweep Start]	Starts the external sweep.
[Sweep Step]	Goes to next step of external sweep.
[Send Seq Tones]	Equivalent to *[Send Tones]* on main menu.
[Recall Up]	Recall next store.
[Recall Down]	Recall previous store.
[No Ext. Trigger]	Trigger ignored (default)

A switch closure or voltage transition from +5 V to 0 V applied to the rear panel socket initiates the trigger action.

Time and date

Press *[Time and Date]* and the screen shows the current time, date and day of the week. The time shown does not change during display. The clock is powered by a rear panel battery, see Chap. 2, 'BATTERY REPLACEMENT'.

Setting the modulation mode

Press *[Mod'n Mode]* to display the *Modulation Mode Selection Menu*, choose the type of modulation required by pressing *[Single]*, *[Dual]*, *[Comp]* or *[Dual Comp]* see Page 3-1-17, 'Modulation mode selection'.

Setting the GPIB address

Press *[GPIB Address]* to display the *GPIB Address Change Menu*. To change the address, enter the address, in the range 0-30, via the numerical key pad and press [enter]. The data is then saved automatically in the non-volatile memory. For information on operating the instrument via the GPIB, refer to Chapter 3-2.

Sequential calling tones

Sequential calling tones are set up from a utility menu, Fig. 3-1-25, and are activated by pressing *[Send Tones]* which appears on the main menu after the tones have been set up. *[Send Tones]* also appears on the calling tones menu. Pressing the *[Calling Tones]* soft key at *Utilities Selection Menu 1* calls up the *Sequential Calling Tones Utility* menu, see 'SIGNALLING'.

Carrier phase adjustment

Pressing [Carrier Phase] displays the Carrier Phase Control Menu. To advance or retard the carrier phase (with respect to its current phase) in steps of $\pi/128$ radians, approximately 1.4°, rotate the control knob clockwise to advance the phase and counter-clockwise to retard the phase.

Selection of frequency standard

Pressing *[Int/Ext Standard]* changes the menu to display the *Frequency Standard Selection Menu* which has the following options:

1 MHz Int. Std.
5 MHz Int. Std.
10 MHz Int. Std.
1 MHz Ext. Std.
5 MHz Ext. Std.
10 MHz Ext. Std.

If the internal standard is selected, it is available as an output at the selected frequency on the rear panel. Selecting an external option enables the instrument to accept a standard from an external source at that frequency. These settings are saved in the non-volatile memory.

Selection menu 2

Press *[Utils Menu 2]* from *Utilities Selection Menu 1*. The display now changes to show *Utilities Selection Menu 2*, see Fig. 3-1-27. This menu allows access to the protected data. Utilities on this menu have either 1st or 2nd level protection.

If the instrument is locked, the appropriate level must be unlocked otherwise the utility will only be usable in a read only mode. To change parameters, the function must be unlocked. The procedure is:

[UTIL] →<deleted ASCII 174> *[Utils. Menu 2]* →<deleted ASCII 174> *[Lock & Unlock]* →<deleted ASCII 174> *Function Unlocking Utility* menu →<deleted ASCII 174> *[Unlock Level 1]* or, for servicing, *[Unlock Level 2]*.

The correct password must be entered. Many of these activities are intended for use in servicing and are described in the Service Manual.

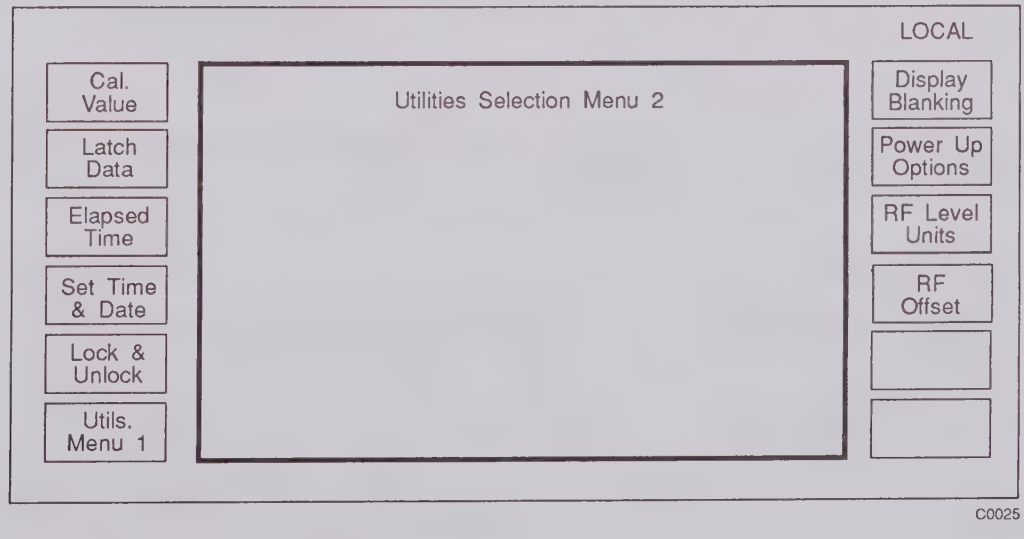


Fig. 3-1-27 Utilities selection menu 2

Calibration

Pressing *[Cal. Value]* brings the *Calibration Utilities Menu* to the display, see Fig. 3-1-28. This menu shows when the last complete check was made and when the next calibration check is due. It also shows the date on which the individual items were adjusted. It is possible to inspect the calibration value of these items but calibration cannot be carried out unless the protection facility is unlocked at Level 2. Full details regarding calibration can be found in the Service Manual.

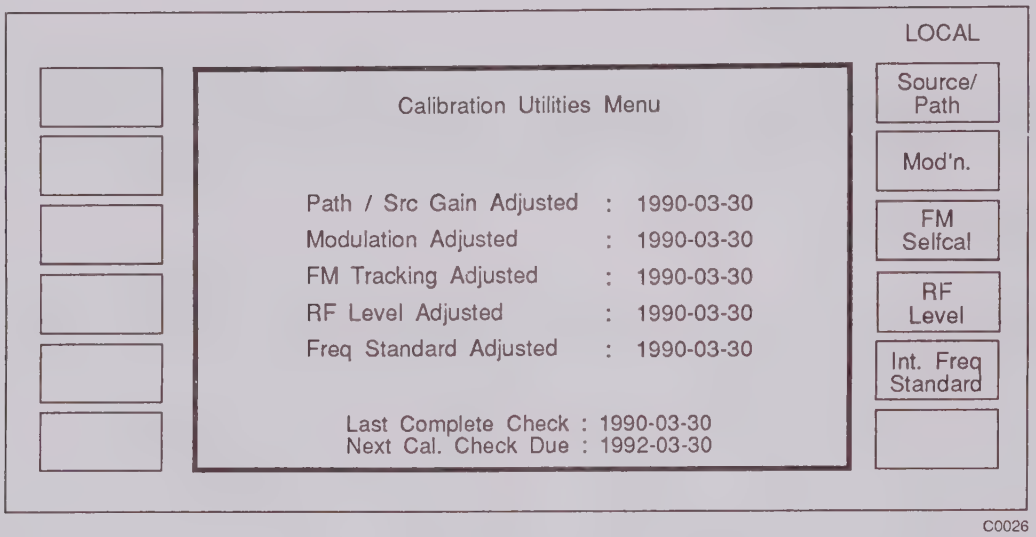


Fig. 3-1-28 Calibration utilities menu

Latch data

The latch data menu is intended for use as a diagnostic aid by allowing data to be sent to latches within the instrument. For further information consult the Service Manual.

Elapsed time

Pressing *[Elapsed time]* displays the number of operating hours which have elapsed since the timer was reset and the date of the reset.

Set time and date

To set the time and the date, the instrument must be unlocked to Level 2, see Service Manual for further information.

Locking and unlocking

Press *[Lock & Unlock]*. When Level 1 and Level 2 are both locked, the menu displays three soft keys:

Unlock Level 1
Unlock Level 2
Serial No. Set

Press *[Unlock Level 1]* and the message *Enter 4 Digit Password*: will appear on the display. Level 1 is unlocked by entering the 4 digits on the key pad and pressing [enter]. The menu will change and two soft keys, *[Lock level 1]and [Lock Keyboard]*, will appear on the left hand side. The default password is 1234. If this password is not recognised by the instrument, then the password has been changed by your calibration/repair department personnel who should be consulted for further information. *[Unlock Level 2]* is only used during servicing. Refer to the Service Manual for details.

Keyboard locking

Unlock to Level 1, see Pages 3-1-35, 'Selection Menu 2' and 3-1-36, 'Locking and Unlocking'. Keyboard operation is disabled by pressing *[Lock Keyboard]*. The instrument automatically returns to the main menu which indicates the locked status by displaying a key shaped icon in the top left-hand corner of the display. The keyboard can be re-enabled by entering the 4 digit password for Level 1 using the key pad and pressing *[enter]*. The keyboard status is saved in the non-volatile memory.

Display blanking

To prevent sensitive data from being displayed, the 2030 Series Signal Generators include a display blanking facility. This allows various parts of the display to be replaced by a series of dashes so that values entered by the user or recalled from the memory will not be visible. The instrument must be unlocked to Level 2 to enable or disable this facility. Consult the Service Manual for further information.

Power up options

Unlock to Level 1, see pages 3-1-35, 'Selection Menu 2' and 3-1-36, 'Locking and Unlocking'. Two options are available by pressing *[Power Up Options]* at *Utilities Selection Menu 2*. These options are *[Factory]* and *[Memory]*. When *[Factory]* is pressed, the factory set power up state is recalled. Pressing *[Memory]* causes *[Memory Number]* to appear at the right hand side of the menu. To change the power up state of the instrument to a particular setting, enter the memory number of the full store on the key pad and press [enter].

RF level units

With the instrument unlocked to Level 1, pressing [RF Level Units] changes the menu as shown in Fig. 3-1-29.

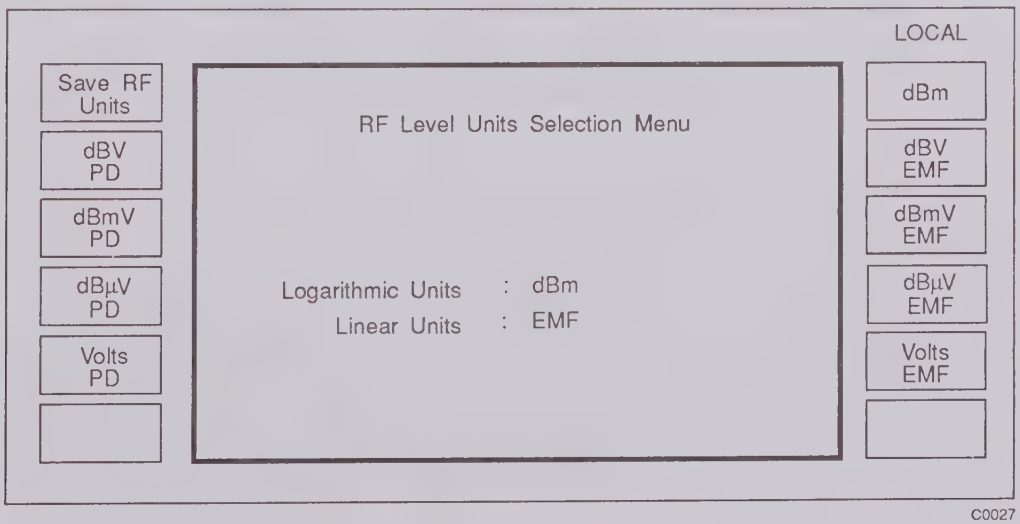


Fig. 3-1-29 RF Level units selection menu

The RF level units as shown on the Sig Gen menu can be altered at the *RF Level Units Selection Menu.* A linear unit, EMF or PD, is in use when the [V], [mV] or [μV] hard keys are pressed. When the [dB] key is pressed, the unit shown at the display will be a logarithmic one, dBm or dB relative to a volt, millivolt or microvolt, EMF or PD. To change the units from dBm to dBmV EMF, press the soft key next to the unit required, i.e. *[dBV EMF].* The selected units should then be saved to the non-volatile memory using the *[Save RF Units]* key.

RF offset

To compensate for cable or switching losses or to standardize a group of instruments so that they give identical measurements, the RF output level can be offset by up to ±2 dB. This is done by selecting *[Offset Value]* and either keying in the value or making the adjustment with the control knob. A separate offset can be set for the carrier frequency range 10 kHz to 337.5 MHz and each octave above this. Offsets can be turned on or off individually using the *[Offset ON/OFF]* key or all offsets can be turned on or off via the *[Enable/Disable]* key. With the instrument unlocked to Level 1, see Page 3-1-36, 'Locking and unlocking', pressing *[RF Offset]* produces the layout for the soft keys shown in Fig. 3-1-30.

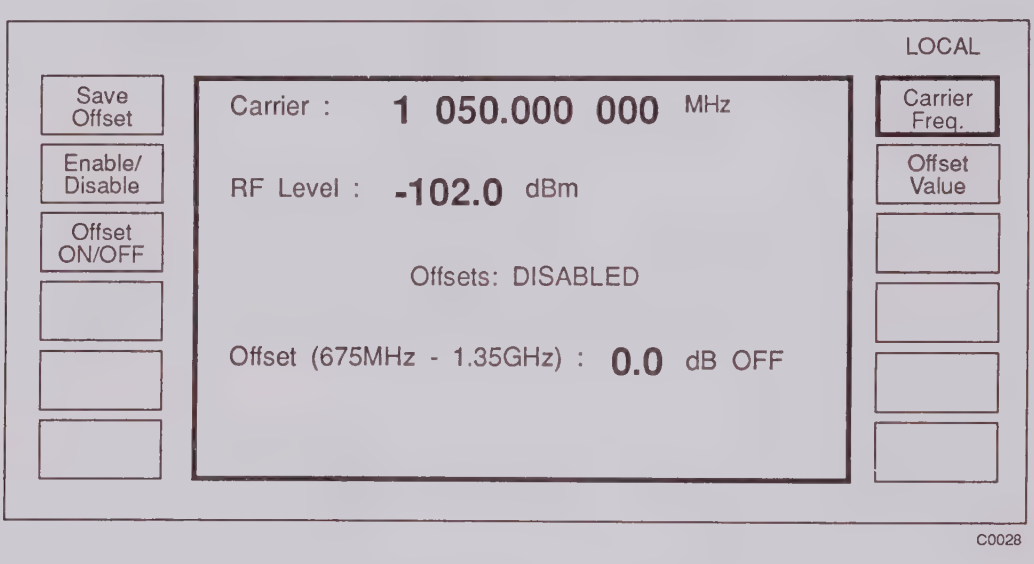


Fig. 3-1-30 RF offset adjustment menu

LOW FREQUENCY OPERATION

The instrument has two modes of LF operation. The LF output can be used either as a modulation signal monitor or as an independent low frequency generator. Pressing [LF] displays either the *LF Monitor Menu* or the *LF Generator Menu*, depending on which mode was last selected.

LF monitor

The left hand side of the LF Monitor Menu, varies according to the modulation mode; single, composite, dual or dual composite. In each case the right hand side is occupied by a single soft key, *[LF Gen.]*.

TABLE 3-1-1
LIST OF AVAILABLE SOFT KEYS FOR DIFFERENT MODULATION MODES

Single	Composite	Dual	Dual Composite
Mod. Drive	Mod. Drive	AM Drive	AM Drive
-	Mod. 1 Source	AM Source	AM 1 Source
-	Mod. 2 Source	-	AM 2 Source
-	-	FM/FM Drive	FM/FM Drive
-	-	FM/FM Source	FM/FM 1 Source
-	-		FM/FM 2 Source

Modulation source monitoring

Internal sources only may be monitored. To monitor a modulating signal source, press the appropriate key. The source monitor level and the source information appear on the display. The modulating signal output is fed to the LF OUTPUT socket at a fixed level of 1 V.

Modulation drive monitoring

Modulation drive monitoring is intended for the user to monitor complex modulating signals from both internal and external sources. To monitor a modulation drive, press the appropriate key. The LF Monitor Level and the selected drive are displayed.

When the summed AM drive signal is selected, a signal which is the sum of both AM channels is fed to the LF OUTPUT socket, if in a composite or dual composite mode. The LF level function controls the output level at 100% depth, therefore the actual output voltage depends on the modulation depth. If AM is turned off, the associated LF output is removed.

The summed FM/ΦM drive signal is also fed to the LF OUTPUT socket. The signal is the sum of both FM/ΦM channels. The FM drive signal at the monitored point is nominally 1 V but varies over a range of approximately 3 dB (except at deviation values below about 1 kHz) depending on the set modulation and the carrier frequency selected. If FM/ΦM is turned off, the LF signal is removed. If one component of a composite modulation setting is turned off, the component which is left on remains at its original level.

Note...

Wideband FM and Pulse modulating signals are not accessible via the monitor mode.

Use as an independent LF generator

To use the instrument as an independent LF generator, select *[LF Gen.]* at the *LF Monitor Menu*. The *LF Generator Menu* appears on the display as shown in Fig. 3-1-31.

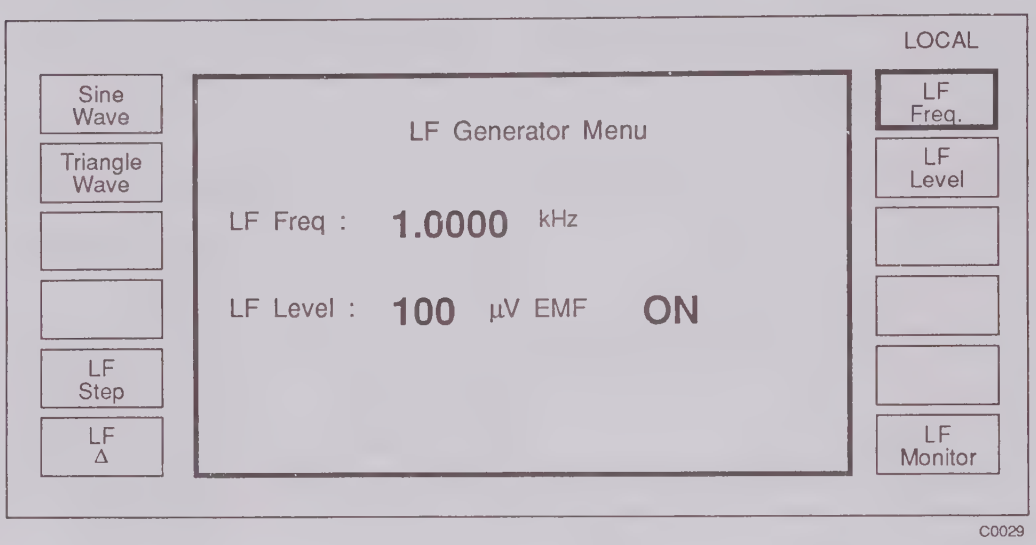


Fig. 3-1-31 LF generator menu

In this mode, one internal oscillator must be used exclusively for this task. Consequently if only one oscillator is fitted, no internal modulation is available to the signal generator while the LF generator is in use. If a second oscillator is fitted, only one is available to the signal generator.

LF frequency and LF level are adjusted by pressing the appropriate key and entering the value via the numerical keypad and pressing [enter]. To set step values, press *[LF Step]* for the *LF Step Menu*. *[Freq. Step]* or *[Level Step]* can be selected and the values entered as before. To display the *LF Total Shift Menu*, press *[LF Δ]*.

To regain the oscillator as a modulation source, select the monitor mode.

Note...

The LF output is entered as V/mV/µV representing the open circuit voltage fed to a high impedance, but the steps are entered in dB and the control knob has a fixed resolution of 0.1 dB.

MEMORY

Pressing the [MEM] hard key causes the store/recall menu, Fig. 3-1-32, to be displayed. There are four types of store, full, partial, carrier frequency and sweep. Provision is made for an option not to recall the carrier frequency for full and partial stores. This allows one carrier freqency to be used with a series of stored settings. Pressing *[Inhibit ON/OFF]* turns the option ON and OFF. The state of the option is indicated on the display.

To prevent the accidental overwriting of memory contents, a store protection facility is provided. If this feature is enabled, the screen legend will indicate *'Store Protect: ON'* and the store key legends at the left of the screen will not appear.

Note ...

Sequential calling tone sequences can be stored from the *Sequential Calling Tones Utility* menu. There is provision for storing up to 20 tone sequences.

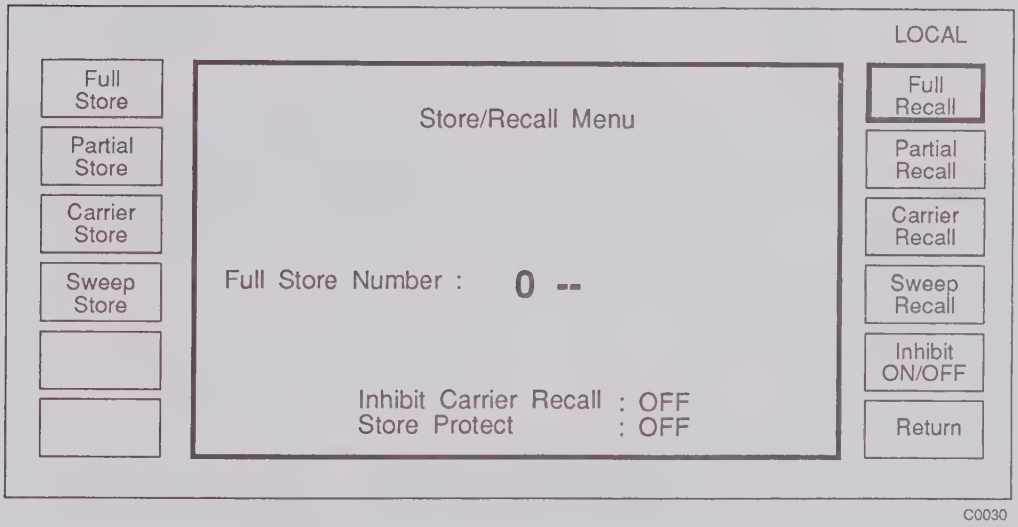


Fig. 3-1-32 Store/recall menu

Full store/recall

Selecting *[Full Store]* enables the storage of a complete instrument setting, i.e. carrier frequency, RF level, modulations and their increments, ON/OFF and source information. Also stored are all 6 modulation oscillator frequencies, plus one increment, and the LF Generator/Monitor setting. *[Inhibit Carrier]* provides the option not to recall the carrier frequency setting. There are 50 locations (numbered 0 to 49) for full storage and full recall. A further location (50) allows the factory default settings to be recalled. This memory cannot be written to by the user. The factory default settings are as described under *RST or Page 3-2-5.

A Full Store contains the following information:

Carrier frequency setting
Carrier frequency step size
RF level setting
RF level step size
All modulation settings
All modulation step sizes
Modulation mode and status
All six internal oscillator frequency settings
The modulation frequency step size
LF Generator frequency setting
LF Generator frequency step size
LF Generator level setting
LF Generator level step size
LF Monitor settings
Display blanking settings

Partial store/recall

This is a less comprehensive store of only those parameters which currently affect the RF output; carrier frequency, RF level, modulations in use (without increments), ON/OFF and source information and the two modulation oscillator frequencies in use. As with the full store, the option not to recall the carrier frequency is provided. There are 50 locations (numbered 0 to 49) for partial storage.

A Partial Store contains the following information:

Carrier frequency setting
RF level setting
The active modulation settings
Modulation mode and status
The frequency of the active modulation frequencies
Either the LF Generator frequency and level setting or the LF Monitor setting (depending on which mode is selected)

Carrier store/recall

The carrier frequency store has 100 locations (numbered 0 to 99) for the storage of carrier frequency only. This store can be used in conjunction with the full and partial stores to apply a set of test conditions to a range of frequencies.

Sweep store/recall

The sweep store has 20 locations (numbered 0 to 19) for the storage of complete sets of sweep parameters.

Note...

Sweep parameters can be stored or recalled whether the instrument is in sweep mode or not. They are only used when sweep is selected.

Store and recall

To store information, press the soft key for the type of store required, e.g. *[Partial Store]*, see Fig. 3-1-32, define a store location via the numerical key pad, and press [enter]. To recall data, press the soft key for the type of recall required, e.g. *[Carrier Recall]* and select the location by means of the keypad. The [⇑] and [⇓] keys can be used to to recall the next locations. Pressing *[Return]* recalls the location last specified on the numerical key pad.

Note...

The settings for the sequential calling tones are stored and recalled via the calling tones menu in UTILITIES, see Fig. 3-1-25. These stores can be erased from the *Store Erase Menu.*

Store erase

Unlock to Level 1. Pressing *[Store Erase]* causes the *Store Erase Menu*, to appear on the screen. The opportunity to erase all the stores of a given type is available by pressing the relevant key and pressing *[Erase]*.

Inhibit ON/OF

When recalling full or partial stores it is sometimes useful for the existing carrier frequency setting to remain and not be replaced by the stored setting. The Inhibit Carrier Recall facility offers this capability. To prevent the current carrier frequency from being replaced use the *[Inhibit ON/OFF]* key to set the *Inhibit Carrier Recall* annunciator to *ON*.

To allow the carrier frequency setting to be overwritten use the *[Inhibit ON/OFF]* key to set the *Inhibit Carrier Recall* annunciator to *OFF*.

Frequency hopping

Carrier frequency hopping is a GPIB operation only available in the normal noise mode. The instrument can be instructed to hop between any of the frequencies contained in the carrier frequency stores and a sequence of up to 1024 hops may be entered. The time interval between hops can also be entered .

Before executing a carrier hopping sequence, the frequencies must be loaded into the carrier frequency stores (0 - 99). This can be achieved via the GPIB using the following commands -

CFRQ < frequency value >
STO:CFRQ < store number >

To enter the frequency hopping mode, enter the following GPIB commands -

IMODE SWEEPER
SWEEP:TYPE HOP

This will cause the screen as shown in Fig. 3-1-33 to appear on the signal generator -

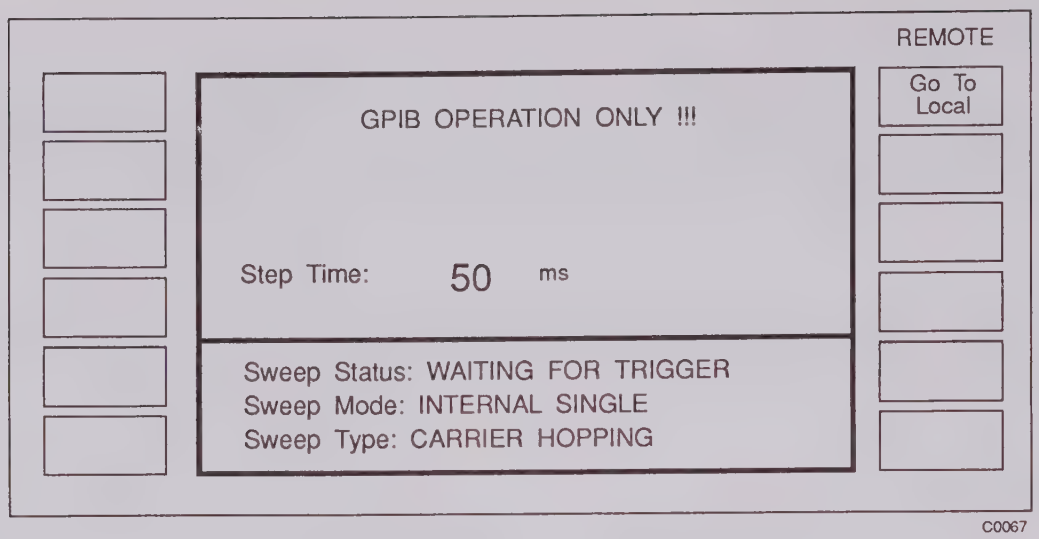


Fig. 3-1-33 Frequency hopping menu

To load in a sequence, the following command is used -

HOPSEQ<n0>,<n1>,<n2>,<n3>,<n4>.....

where <n0> - <n> are numeric values in the range 0-99 corresponding to the carrier frequency store at which the necessary frequency is stored. The hopping sequence length is determined by the amount of numbers entered.

The other parameter that can be set to control the hopping sequence is the time between "steps". This is done using the command -

SWEEP:HOP:TIME < t >

where t represents the number of milliseconds.

The 100 frequencies are precalculated and loaded into a software sweep table using the GPIB command -

SWEEP:CALC

Note:...

If any of the carrier frequency stores have become corrupt and so result in a checksum error, the following message will appear in the centre of the screen -

CARRIER STORE < x > CORRUPTED.
RE - ENTER FREQUENCY.

where x is the corrupted store number.

With the frequencies, sequence and step time loaded, the hopping operation is controlled in the same manner as the ordinary sweeps by using the following commands -

SWEEP:GO	starts the hopping sequence (and will do any precalculation if required).
SWEEP:HALT	pause the hopping sequence.
SWEEP:UP	go up to the next step while paused.
SWEEP:DN	go down to previous step while paused.
SWEEP:CONT	continue hopping sequence.
SWEEP:RESET	reset sequence to start value.

When paused the carrier store number is displayed on the screen.

Note...

There are no markers available and the operation of transferring the paused value to the main parameter is not permitted.

To enter a new sequence use the "hopseq" command but the number 255 is inserted at the beginning of the string.

e.g. existing sequence - 0, 6, 53, 72, 43, 96

sequence required - 22, 16, 7, 41, 59, 6

send GPIB command -

```
HOPSEQ  255,22,16,7,41,59,66
```

To add to an existing sequence use the "hopseq" command without 255 at the beginning of the string.

e.g. existing sequence - 12, 24, 36, 48

sequence required - 12, 24, 36, 48, 60, 72, 84

send GPIB command -

```
HOPSEQ  60,72,84
```

To determine the length of the hopping sequence the following GPIB command is used -

```
HOPSEQ?
```

This returns a value 1 - 1024.

Like "other" sweep settings the frequency hopping mode can be set to -

single sweep (internal trigger),
continuous sweep (internal trigger) or
external sweep (external trigger)

by using the following commands -

```
SWEEP:MODE SNGL
SWEEP:MODE CONT
SWEEP:MODE EXT
```

For externally triggered operation the trigger facility can be used in the same manner as another sweep function.

ERROR HANDLING

Errors may be divided into three groups - Foreground Errors generally caused by a user, Background Errors which represent a condition of the instrument and GPIB Errors which occur only when the unit is being controlled by a GPIB controller.

Foreground errors

Attempts to set the instrument to a parameter value outside its known range result in the generation of an error message.

For example, trying to select a carrier frequency above or below the specified range results in the message *Carrier Outside Limits* being displayed at the top of the screen.

Foreground Errors are cleared automatically when a correct entry is made by the user.

Background errors

An incorrect operating condition within the instrument automatically generates an error message to warn the operator. For example, if the internal frequency standard should fail the message *Int. Standard Failure* will be displayed at the top of the screen.

GPIB errors

Errors caused by incorrect programming are displayed at the top of the screen and may also generate a Service Request if the relevant status registers are set.

Error display - Front panel

Errors are displayed as a single line of text at the top of the screen. If more than one error is present an internal priority ordering algorithm determines which error is displayed.

Error display - GPIB

When an error occurs, its number is entered into the Error Queue. Errors are not removed from the queue when they are cleared, but only by the ERROR? query, which returns the error at the head of the queue, or by the *CLS command which clears the whole queue. When the queue contains an error entry, a bit (<erb>) on the status byte is set (see Page 3-2-47).

The error queue has a capacity of 100 error numbers. If an error occurs while the queue is full then last error number is replaced with 255 so that the ERROR? query returns a value of 255 to indicate a full queue. An empty queue returns a value of 0 following an ERROR? query.

In addition to the error queue entry, the appropriate bit in the Standard Event Register (see Page 3-2-42) will also be set (one of <cmd>, <exe>, <dde> or <qye>). Many background errors are also reported in the Hardware and Coupling Status Registers (see Page 3-2-43 and 3-2-44).

ERROR MESSAGES

TABLE 3-1-2 BACKGROUND ERRORS

Error No.	Error Type	Descriptive text	Error No.	Error Type	Descriptive text
1	dde	RPP Tripped	6	dde	VCXO Out of Lock
2	dde	Fractional N Out of Lock	7	dde	Ext1 Too Low
3	dde	Int. Standard Failure	8	dde	Ext1 Too High
4	dde	Ext. Standard Failure	9	dde	Ext2 Too Low
5	dde	Incorrect Ext. Standard	10	dde	Ext2 Too High
11	-	-	16	-	-
12	-	-	17	exe	RF Level limited by AM
13	-	-	18	exe	FM limited by Carrier
14	-	-	19	exe	WBFM limited by Carrier
15	-	-	20	exe	AM2 limited by AM1
21	exe	FM2 limited by FM1	26	dde	Real Time Clock Problem
22	exe	PM2 limited by PM1	27	dde	Calibration Date Expired
23	exe	Steps limited by Span	28	dde	Pad Calibration Checksum
24	exe	FM Selfcal Error	29	dde	RF Calibration Checksum
25	dde	Internal Osc.1 Missing	30	dde	FM Calibration Checksum
31	dde	Path/Source Calibration	36	-	-
32	dde	Absolute Mod. Calibration	37	-	-
33	dde	Freq. Std. Calibration	38	-	-
34	-	-	39	-	-
35	-	-	40	-	-

TABLE 3-1-3 FOREGROUND ERRORS

Error No.	Error Type	Descriptive text	Error No.	Error Type	Descriptive text
46	exe	Recall Checksum	51	exe	Carrier Outside Limits
47	exe	Incorrect Setup	52	exe	RF Level Outside Limits
48	exe	Invalid Memory Number	53	exe	Mod Rate Outside Limits
49	exe	MODULATION NOT ENABLED	54	exe	LF Freq. Outside Limits
50	exe	Out of Range	55	exe	LF Level Outside Limits
56	exe	AM Outside Limits	61	exe	RF Level Step Too Big
57	exe	FM Outside Limits	62	exe	Mod Rate Step Too Big
58	exe	PM Outside Limits	63	exe	LF Freq. Step Too Big
59	exe	WBFM Outside Limits	64	exe	LF Level Step Too Big
60	exe	Carrier Step Too Big	65	exe	AM Step Too Big
66	exe	FM Step Too Big	71	exe	Sweep Stop Out of Range
67	exe	PM Step Too Big	72	exe	Sweep Steps Out of Range
68	exe	Invalid Latch Number	73	exe	Sweep Time Out of Range
69	exe	Invalid Latch Data	74	exe	Sweep Marker Out of Range
70	exe	Sweep Start Out of Range	75	exe	Attenuator EAROM Read

TABLE 3-1-3 FOREGROUND ERRORS (continued)

76	exe	Attenuator EAROM Write	81	exe	EAROM Wrap Around Error
77	-	-	82	exe	Continuous Tone Checksum
78	-	-	83	exe	Sequential Tone Checksum
79	exe	EAROM Write Error	84	exe	Tone data Out of Range
80	exe	EAROM Read Error	85	exe	Tone Offset Out of Range
86	exe	Clock Data Entry Error	91	exe	RF levelling fault
87	exe	At Top Limit	92	exe	REPEAT THIS CALIBRATION
88	exe	At Bottom Limit	93	exe	-
89	exe	Ext. Trigger Disabled	94	-	-
90	dde	Int. Std. Not Selected	95	-	-

TABLE 3-1-4 GPIB ERRORS

Error		Descriptive text	Error		Descriptive text
No.	Type		No.	Type	
101	-	-	106	cmd	Data Expected
102	cmd	Mnemonic Fault	107	cmd	Illegal Data
103	cmd	Block Definition	108	cmd	Terminator Expected
104	cmd	Block Size	109	cmd	GET Error
105	cmd	Numeric Syntax	110	cmd	EOM Error
111	exe	Illegal Modulation Mode	116	qye	Unterminated
112	exe	No Such Monitor Mode	117	qye	Interrupted
113	exe	Cannot Monitor	118	qye	Deadlock
114	exe	Instrument Mode Wrong	119	cmd	Missing Quote
115	cmd	Lost Data After Comma	120	cmd	Terminator Expected
121	exe	String Length	126	exe	Illegal Seq Tones Mode
122	exe	Illegal Tone Character	127	exe	Overflow
123	exe	Illegal Duration Char	128	cmd	Data Too Long
124	exe	Illegal Standard	129	exe	Voltage Type Error
125	exe	Illegal Save Destination	130	exe	Sweep Not Possible
131	exe	Unknown Cal Point	136	exe	Unknown Freq. Standard.
132	exe	Unknown RF Band	137	exe	User Data Locked
133	exe	Unknown Instrument Mode	138	exe	Trigger Unknown
134	exe	User Data Checksum	139	exe	Illegal Tones Operation
135	qye	Query Lost after arb. char	140	cmd	Error in Char Data
141	exe	Wrong RF units	146	exe	Wrong Family For Command
142	cmd	Data Unknown	147	exe	Not Suitable For Hopping
143	exe	Negative Value Illegal	148	exe	Hopping Sequence Full
144	exe	Illegal Modulation Mode	149	-	-
145	exe	Unavailable Mod Source	150	-	-

TABLE 3-1-5 FATAL ERRORS

Error		Descriptive text	Error		Descriptive text
No.	Type		No.	Type	
171	exe	Main RAM Faulty	176	-	-
172	exe	Main PROM Faulty	177	-	-
173	exe	Microwave Board Error	178	-	-
174	exe	Attenuator Type Unknown	179	-	-
175	exe	Wrong Attenuator fitted	180	-	-

Chapter 3-2

GPIB OPERATION

INTRODUCTION

The 2030 Series signal generators can be operated remotely from a personal computer fitted with a GPIB interface card or a dedicated GPIB controller. All functions can be controlled by coded messages sent over the interface bus via the 24 way socket on the rear panel of the instrument. IEEE Standard 488.2 (1987) is implemented, which defines the protocols and syntax of commands.

The instrument can function either as a talker or a listener. In the listen mode, it will respond to IEEE 488.2 common commands and queries and device-specific commands and queries. These allow various device functions to be controlled and operating parameters to be set. In the talk mode, device status information and parameter settings can be read from the instrument.

For full information on the IEEE protocols and syntax the IEEE 488.2 Standard should be consulted.

GPIB FUNCTIONS

The IEEE 488.1 interface functions offered by 2030 Series are as follows:

Source handshake (SH1)	complete capability.
Acceptor handshake (AH1)	complete capability.
Talker (T6)	basic talker, serial poll, unaddress if MLA.
Listener (L4)	basic listener, unaddress if MTA.
Service Request (SR1)	complete capability.
Remote/Local (RL1)	complete capability.
Device clear (DC1)	complete capability.
Device trigger (DT1)	complete capability
Parallel Poll (PP0)	no capability.
Controller (C0)	no capability.
Tri-state drivers (E2)	as opposed to open collector drivers.

DEVICE LISTENING ELEMENTS

The following is a list of the Device Listening Elements (as defined in the IEEE 488.2 standard) which are used in the 2030 Series of signal generators:

<PROGRAM MESSAGE>
<PROGRAM MESSAGE TERMINATOR>
<PROGRAM MESSAGE UNIT>
<PROGRAM MESSAGE UNIT SEPARATOR>
<COMMAND MESSAGE UNIT>
<QUERY MESSAGE UNIT>
<COMPOUND COMMAND PROGRAM HEADER>
<COMPOUND QUERY PROGRAM HEADER>
<PROGRAM HEADER SEPARATOR>
<PROGRAM DATA>
<PROGRAM DATA SEPARATOR>
<DECIMAL NUMERIC PROGRAM DATA>
<CHARACTER PROGRAM DATA>
<SUFFIX PROGRAM DATA>
<STRING PROGRAM DATA>
<ARBITRARY BLOCK PROGRAM DATA>

DEVICE TALKING ELEMENTS

The following is a list of the Device Talking Elements (as defined in the IEEE 488.2 standard) which are used in the 2030 Series of signal generators:

<RESPONSE MESSAGE>
<RESPONSE MESSAGE TERMINATOR>
<RESPONSE MESSAGE UNIT>
<RESPONSE MESSAGE UNIT SEPARATOR>
<COMPOUND RESPONSE HEADER>
<RESPONSE HEADER SEPARATOR>
<RESPONSE DATA>
<RESPONSE DATA SEPARATOR>
<NR1 NUMERIC RESPONSE DATA>
<NR2 NUMERIC RESPONSE DATA>
<ARBITRARY ASCII RESPONSE DATA>
<CHARACTER RESPONSE DATA>
<STRING RESPONSE DATA>
<DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>

PROGRAMMING

Program messages

A message consists of one or more message units. Message units are separated by a semi-colon (;). The whole message is ended by the Program Message Terminator (or End Of Message) defined as one of the following:

(1) <newline> (ASCII 10 - often known as 'line feed') or
(2) <newline> + END (the EOI line is asserted as well) or
(3) + END (EOI is asserted in the last data byte of the message)

Note ...

A response message is always terminated by <EOM> consisting of <newline> + END.

A message unit consists of a mnemonic header which may be followed by data. If data follows, then it must be separated from its header by at least one space

<header><SPACE><data>
e.g. RFLV:INC 6.0 dB

Spaces may be freely inserted in a message to improve readability, except within a header or within data.

A header may be a command or a query. A query has a '?' as its final character and causes the generation of a response message which will be read by the controller. Common commands and queries (defined in IEEE 488.2) begin with a '*'.

Upper and lower case characters are considered equivalent (i.e. FM fm Fm fM are all interpreted by the 2030 Series in the same way).

Compound headers

The 2030 Series implements compound headers which allow a complex set of commands to be built up from a small set of basic elements in a 'tree and branch' structure. The elements of a compound header are separated by a colon (:). Spaces are not allowed within a header.

Special rules apply when more than one compound header is used in one message. When the separator ';' is encountered, all headers except the trailing element of the previous header in the message are assumed to precede the following header, for example:

AM:DEPTH 30PCT;ON

is equivalent to the two commands:

AM:DEPTH 30PCT
and AM:ON

This does not apply to common commands (*RST etc.). The rule may be overridden by preceding a header with a colon, for example:

AM:ON;:FM:ON

Most main functions have a short form of header which may be used for clarity and brevity in simple messages, for example:

CFRQ 1.25GHZ is the same as CFRQ:VALUE 1.25GHZ

Program data

Data can take many forms, as follows:

Decimal Numeric Data is a flexible numeric format which encompasses integer, fixed point and floating point (mantissa and exponent) representations. Data is rounded to a resolution appropriate to the function. Decimal data can, in most cases, be followed by the appropriate units. If no units are present, the specified default units are assumed.

Character Data is an alphanumeric word.

String Data consists of a number of 7-bit ASCII characters enclosed in quotes, either a pair of single ('ASCII 39') or double ("ASCII 34") quotes may be used.

Block Data is used by *PUD and allows a number of 8-bit bytes to be transferred. For further information see the Service Manual.

Some commands can accept Multiple Data items which are separated by commas, for example MODE FM,AM.

Message exchange protocol

The controller should not attempt to read a response until it has sent the entire query message (terminated by EOM). Also, it should not start to send a new message until it has read the entire response (terminated by EOM). The query message may contain more than one query message unit, but only one response message (containing several response message units) is generated.

Failure to follow the protocol will generate a query error:

UNTERMINATED (error 116) occurs when the controller attempts to read a response without having sent a query.

INTERRUPTED (error 117) occurs when the controller starts to send a new message before having read the response to a preceding query.

DEADLOCK (error 118) can only occur if the input and output buffers are both filled by the controller having sent an extra long Message containing several query message units.

The 2030 Series have input buffer stores of 256 characters and an output buffer of two response message units.

Remote/local operation

When the 2030 Series Signal Generator is addressed by the controller it will enter its remote mode and the screen will have only one key legend, *[LOCAL]*. Pressing this key returns the unit to normal manual operation, unless Local Lockout has been asserted by the controller.

Common commands and queries (IEEE 488.2)

The IEEE 488.2 standard defines a set of common commands and queries which implement common system functions.

Common command and query mnemonics are preceded by an asterisk (*) to distinguish them from device dependent data such as instrument programming strings. The following common commands and queries are implemented in the 2030 Series:

Mnemonic	Name and Description
*IDN?	Identification Query. Returns an arbitrary ASCII response comprising four data fields in the format: <Manufacturer>,<type number>,<serial number>,<firmware version number><EOM>. Example: `MARCONI INSTRUMENTS,2031,123456789,2.001<EOM>`
*OPT?	Option Identification Query. Returns an arbitrary ASCII response containing a data field for each fitted option in the format: <option a>,<option d>, ... ,<option *n*><EOM> Example: `SECOND OSCILLATOR,PULSE MODULATION,+19 dBm OUTPUT<EOM>` If no options are fitted, ASCII '0' is returned.

Note...

Because an Arbitrary ASCII Response ends with the Response Message Terminator (<EOM>) either *IDN? or *OPT? must be the last Query Message Unit in a Program Message.

*RST	Reset Command. Sets the instrument functions to the factory default power up state. The default settings appear in Table 3-2-1.
*TST?	Self Test Query. Returns a '0' when the GPIB interface and processor are operating.
*OPC	Operation Complete Command. Sets the Operation Complete bit in the Standard Event Status Register when execution of the preceding operation is complete.
*OPC?	Operation Complete Query. Returns a '1' when the preceding operation has been completed.
*WAI	Wait to Continue Command. Inhibits execution of an overlapped command until the execution of the preceding operation has been completed.
*TRG	Trigger Command. Equivalent to Group Execute Trigger.
*PUD <block>	Protected User Data Command. Sets the Protected User Data, accepts Definite Block Data when enabled. This command is covered in further detail in the Service Manual.

*PUD? Protected User Data Query. Returns the User Data as a Definite Block Response.

Example: `#221Inventory Number 1234`

*STB? Read Status Byte Query. Returns the value of the Status Byte as an nr1 number (0-255).

*SRE <nrf> Service Request Enable Command. Sets the Service Request Enable Register.

*SRE? Service Request Enable Query. Returns the value of the Service Request Enable Register as nr1.

*ESR? Standard Event Status Register Query. Returns the value of the Status Event Status Register as nr1.

*ESE <nrf> Standard Event Status Enable Command. Sets the Standard Event Enable Register.

*ESE? Standard Event Status Enable Query. Returns the value of the Standard Event Status Enable Register as nr1.

*CLS Clear Status Command. Clears all the Status Event registers and clears the Error Queue. Does not affect the Enable Registers.

Note...

The IEEE 488.2 Device Clear function only affects the GPIB functions. The input and output buffers are cleared and the instrument put into a state to accept new Messages. It no longer puts the instrument functions into a defined state, this is now performed by the *RST common command.

DEVICE DEPENDENT COMMANDS

The following list describes the features of the device dependent mnemonics for the 2030 Series signal generators together with simple examples of their use within each major section (Carrier frequency, RF Level, etc.) the root mnemonic is listed first followed by the lower level mnemonics. Each group is followed by a list of requirements for data type and suffix.

In addition to the normal listen commands the 2030 Series accept query commands which cause the instrument to prepare a message which will be sent to the controller when the instrument is next addressed to talk. For each query an example of a response is given. Where responses are similar for a group of queries not all are listed. Some queries can produce more than one type of response - an example of each is usually given.

In the list which follows, the abbreviations <char>, <nrf> and <str> have the following meanings:

<char> = Character Program Data
<nrf> = Decimal Numeric Program Data
<str> = String Program Data

Where the data format is Decimal Numeric Program Data, the value may be expressed as a signed or unsigned number in any of the following formats:

nr1: Decimal integer, e.g. 1234 or -567
nr2: Floating point number, e.g. 1.234 or -56.789
nr3: Floating point number with exponent, e.g. 1.2345E5 or -12.47E-8

DEFAULT SETTINGS

These are the settings assigned to instrument functions in the following cases:

(i) Power-up to factory default settings.

(ii) Execution of *RST command.

(iii) Recall Full Store 50.

The instrument functions set to the factory default power-up state by the reset command (*RST) are as shown in Table 3-2-1

TABLE 3-2-1 INSTRUMENT DEFAULT SETTINGS

Instrument Mode	:	Normal
Carrier Frequency	:	(Maximum available) 1.35 GHz/2.7 GHz/5.4 GHz
Step	:	1 kHz
RF Level	:	(Minimum available) -138 dBm/-144 dBm
Step	:	1 dB Status: ON
Modulation Mode	:	Single FM , Modulation enabled

TABLE 3-2-1 INSTRUMENT DEFAULT SETTINGS (continued)

Modulations	:	FM1	:	0 Hz, Int F4, ON
		FM2	:	0 Hz, Ext 1 ALC, ON
		ΦM1	:	0 rad, Int F4, ON
		ΦM2	:	0 rad, Ext 1 ALC, ON
		AM1	:	0%, Int F4, ON
		AM2	:	0%, Ext 2 ALC, ON
		WBFM	:	(Minimum setting), AC coupled, ON
Steps :		ΔFM 1 kHz, Δ ΦM 0.1 rad, ΔAM 1%		
Modulation source	:	IntF1	:	300 Hz sine
		IntF2	:	400 Hz sine
		IntF3	:	500 Hz sine
		IntF4	:	1 kHz sine
		IntF5	:	3 kHz sine
		IntF6	:	6 kHz sine
Step :		1 kHz		
LF	:	Mode	:	Monitor, Mod Source
LF Generator	:	Frequency	:	1 kHz sine, step 1 kHz
		Level	:	100 μV
		Step	:	1 dB
		Status	:	ON

Sweep:		
Type	:	RF Level
Mode	:	Single Internal
RF Level Sweep :		
Start :		0 dBm Stop: 10 dBm Steps: 100 Time: 50 ms
Markers :		2, 4, 6, 8, 10 dBm, disabled
Carrier Freq. Sweep :		
Start :		100 MHz Stop: (Maximum available) Steps: 250 Time 50 ms
Markers :		200, 400, 600, 800, 1000 MHz, disabled
Mod. source Freq.	:	
Start :		0.1 Hz Stop: 500 kHz Steps: 10,000 Time: 500 ms
Markers :		100, 20, 30, 400, 500 kHz

Sequential Tones :	
Mode :	No modulation selected.
Standard :	CCIR
Sequence :	16 Tone Fs
Duration :	All normal.
Frequency Offset :	0
Extended Duration :	500 ms
Repeat Tone :	E
Start Delay :	200 ms

INSTRUMENT MODE

IMODE Select instrument mode

Data type : Character Program Data (either NORMAL for signal generator operation or SWEEPER for swept operation)
Allowed suffices : None
Default suffix : None

Example: `IMODE NORMAL`

CARRIER FREQUENCY

CFRQ Set Carrier Frequency (short form)
:VALUE Set Carrier Frequency
:INC Set Carrier Frequency step

Data type : Decimal Numeric Program Data
Allowed suffices : Any one of: GHZ, MHZ, KHZ or HZ
Default suffix : HZ

:UP Go UP one step
:DN Go DOWN one step
:RET Return to original setting
:XFER Transfer current value to be the new setting

Data type : None
Allowed suffices : None
Default suffix : None

:PHASE Adjust Phase of Carrier in steps of $\pi/128$ radians (approximately 1.4°) over a range of ±255 steps

Data type : Decimal Numeric Program Data
Allowed suffices : None
Default suffix : None

Examples:
```
CFRQ:VALUE 1.23MHZ;INC 10KHZ
CFRQ:UP;XFER
```

CFRQ? Prepares message containing information on Carrier Frequency setting in the following format:

:CFRQ:VALUE <nr2>; INC <nr2>

Example: `:CFRQ:VALUE 1000000000.0;INC 25000.0`

RF LEVEL

RFLV — Set RF output level (short form)

:VALUE — Set RF output level

Data type : Decimal Numeric Program Data
Allowed suffices : Any one of: DBM, DBV, DBMV, DBUV, V, MV or UV
Default suffix : dBm unless changed by UNITS command

:INC — Set RF level step (dB)

Data type : Decimal Numeric Program Data
Allowed suffices : DB only
Default suffix : DB

:UP — Go UP one step
:DN — Go DOWN one step
:RETN — Return to original setting
:XFER — Transfer current value to be the new setting
:ON — Turn RF output ON
:OFF — Turn RF output OFF

Data type : None
Allowed suffices : None
Default suffix : None

:TYPE — Selects EMF or PD for voltage related units

Data type : Character Program Data (EMF or PD)
Allowed suffices : None
Default suffix : None

:UNITS — Select default RF level units.

Data type : Character Program Data (DBM, DBV, DBMV, DBUV, V, MV or UV)
Allowed suffices : None
Default suffix : None

Examples:

```
RFLV:VALUE -27.3DBM;ON
RFLV:TYPE PD;VALUE 1.23UV
```

RFLV (continued)

:OFFS [not used alone]
:VALUE Set Offset of current band

Data type : Decimal Numeric Program Data
Allowed suffices : DB only
Default suffix : DB

:ON Turn ON offset of current band
:OFF Turn OFF offset of current band
:ENABLE Enable Offsets
:DISABLE Disable Offsets
:SAVE Store Offsets in memory

Data type : None
Allowed suffices : None
Default suffix : None

Example: `RFLV:OFFS:VALUE -0.2DB;ON;ENABLE`

RFLV?

Prepares message containing information on RF Level setting in the following format:

:RFLV:UNIT <unit>;TYPE <type>;VALUE <nr2>;INC <nr2>;<status>

where: <unit> is character program data defining the default RF level units (DBM, DBV, DBMV, DBUV, V, MV or UV), <type> is character program data indicating EMF or PD and <status> is a program mnemonic indicating whether the RF output is ON or OFF.

Examples:
```
:RFLV:UNIT DBM;VALUE -103.5;INC 2.0;ON
:RFLV:UNIT DBV;TYPE EMF;VALUE -83.2;INC 0.5;ON
```

RFLV:OFFS?

Prepares message containing information on RF Level offsets in the following format:

:CFRQ:VALUE <nr2>;:RFLV:OFFS:VALUE <nr2>;<status>;<activity>

where: <status> is a program mnemonic indicating whether the RF offset is ON or OFF and <activity> is a program mnemonic indicating whether the offset mode is enabled or disabled.

Example: `:CFRQ:VALUE 500000000.0;:RFLV:OFFS:VALUE -0.4;ON;ENABLE`

MODULATION MODE

MODE Set modulation mode

Data type : Character Program Data (valid combinations of AM, AM1, AM2, FM, FM1, FM2, PM, PM1, PM2, WBFM or PULSE, see Table below)
Allowed suffices : None
Default suffix : None

Examples:
```
MODE AM,FM
MODE FM1,FM2
```

VALID MODE COMBINATIONS TABLE

Single	Composite	Dual	Dual Composite
AM1	AM1,AM2	AM1,FM1	AM1,AM2,FM1,FM2
FM1	FM1,FM2	AM1,PM1	AM1,AM2,PM1,PM2
PM1	PM1,PM2	AM1,WBFM	AM1,AM2,WBFM
WBFM		PULSE,FM1	PULSE,FM1,FM2
PULSE		PULSE,PM1	PULSE,PM1,PM2
		PULSE,WBFM	

Note...

At any time the '1' may be omitted, for example FM is equivalent to FM1. Order is not important, for example AM,FM is equivalent to FM,AM.

MODE? Prepares message containing information on Modulation Mode in the following format:

:MODE:<mode>

where: <mode> is character program data indicating the modulation mode settings.

Example:
```
:MODE FM1,FM2
```

MODULATION CONTROL

MOD [not used alone]
:ON Turn modulation globally ON
:OFF Turn modulation globally OFF

Examples:
```
MOD:ON
MOD:OFF
```

MOD? Prepares message containing information on Modulation Control in the following format:

:MOD:<status>

where: <status> is a program mnemonic indicating whether the Modulation is globally ON or OFF.

Example:
```
:MOD:ON
```

FREQUENCY MODULATION

FM or FM1 or FM2 — Set FM deviation (short form)
:DEVN — Set FM deviation
:INC — Set FM step size

Data type : Decimal Numeric Program Data
Allowed suffices : Any one of: GHZ, MHZ, KHZ or HZ
Default suffix : HZ

:<src> — Select modulation source where <src> is any one of: INTF1, INTF2, INTF3, INTF4, INTF5, INTF6, EXT1DC, EXT1AC, EXT1ALC, EXT2DC, EXT2AC or EXT2ALC
:ON — Turn FM ON (locally)
:OFF — Turn FM OFF (locally)
:UP — Go UP one step
:DN — Go DOWN one step
:RETN — Return to original setting
:XFER — Transfer current value to be the new setting

DCFMNL — Perform DC FM/WBFM null operation

Data type : None
Allowed suffices : None
Default suffix : None

Examples:
```
FM:DEVN 25KHZ;INTF4;ON
FM1:DEVN 15KHZ;INC 1KHZ;EXT1DC
DCFMNL
```

FM? or FM1? or FM2? — Prepares message containing information on FM setting in one of the following formats:

:FM:DEVN <nr2>;<src>;<status>;INC <nr2>
:FM1:DEVN <nr2>;<src>;<status>;INC <nr2>
:FM2:DEVN <nr2>;<src>;<status>;INC <nr2>

where: <src> is a program mnemonic representing the source of the modulation signal and <status> is a program mnemonic indicating whether the modulation is locally ON or OFF

Example:
```
:FM1:DEVN 25000.0;INTF1;ON;INC 1000.0
```

PHASE MODULATION

PM or PM1 or PM2 Set Phase deviation (short form)
:DEVN Set Phase deviation
:INC Set Phase Modulation step size

Data type : Decimal Numeric Program Data
Allowed suffices : RAD or RADS
Default suffix : RAD

:<src> Select modulation source where <src> is any one of: INTF1, INTF2, INTF3, INTF4, INTF5, INTF6, EXT1DC, EXT1AC, EXT1ALC, EXT2DC, EXT2AC or EXT2ALC

:ON Turn PM ON (local)
:OFF Turn PM OFF (local)
:UP Go UP one step
:DN Go DOWN one step
:RETN Return to original setting
:XFER Transfer current value to be the new setting

Data type : None
Allowed suffices : None
Default suffix : None

Examples:
```
PM:DEVN 2.5RAD;INTF4;ON
PM1:DEVN 1.5RAD;INC 0.1RAD;EXT1AC
```

PM? or PM1? or PM2? Prepares message containing information on Phase Modulation setting in one of the following formats:

:PM:DEVN <nr2>;<src>;<status>;INC <nr2>
:PM1:DEVN <nr2>;<src>;<status>;INC <nr2>
:PM2:DEVN <nr2>;<src>;<status>;INC <nr2>

where <src> is a program mnemonic representing the source of the modulation signal and <status> is a program mnemonic indicating whether the modulation is locally ON or OFF

Example:
```
:PM2:DEVN 2.30;INTF4;OFF;INC 0.05
```

AMPLITUDE MODULATION

AM or AM1 or AM2 — Set AM Depth (short form)
:DEPTH — Set AM Depth
:INC — Set AM step size

Data type : Decimal Numeric Program Data
Allowed suffices : PCT
Default suffix : PCT

:<src> — Select modulation source where <src> is any one of: INTF1, INTF2, INTF3, INTF4, INTF5, INTF6, EXT1DC, EXT1AC, EXT1ALC, EXT2DC, EXT2AC or EXT2ALC

:ON — Turn AM ON (local)
:OFF — Turn AM OFF (local)
:UP — Go UP one step
:DN — Go DOWN one step
:RETN — Return to original setting
:XFER — Transfer current value to be the new setting

Data type : None
Allowed suffices : None
Default suffix : None

Examples:
```
AM:DEPTH 30PCT;INTF4;ON
AM1:DEPTH 40PCT;EXT1DC;ON
```

AM? or AM1? or AM2? — Prepares message containing information on Amplitude Modulation setting in one of the following formats:

:AM:DEPTH <nr2>;<src>;<status>;INC <nr2>
:AM1:DEPTH <nr2>;<src>;<status>;INC <nr2>
:AM2:DEPTH <nr2>;<src>;<status>;INC <nr2>

where <src> is a program mnemonic representing the source of the modulation signal and <status> is a program mnemonic indicating whether the modulation is locally ON or OFF

Example:
```
:AM1:DEPTH 56.6;INTF3;ON;INC 5.0
```

WIDEBAND FM

WBFM Set WBFM deviation (short form)

:DEVN Set WBFM deviation

Data type : Decimal Numeric Program Data
Allowed suffices : Any one of: GHZ, MHZ, KHZ or HZ
Default suffix : HZ

:ON Turn WBFM ON (local)
:OFF Turn WBFM OFF (local)
:AC Select AC coupling
:DC Select DC coupling

Data type : None
Allowed suffices : None
Default suffix : None

DCFMNL Perform DC FM/WBFM null operation

Examples:
```
WBFM:DEVN 10MHZ;ON;AC
WBFM:DEVN 13MHZ;ON;DC;:DCFMNL
```

WBFM? Prepares message containing information on Wideband Frequency Modulation setting in the following format:

:WBFM:DEVN <nr2>;<coupling>;<status>

where <coupling> is a program mnemonic indicating AC or DC coupling of the modulation signal and <status> is a program mnemonic indicating whether the modulation is locally ON or OFF

Example:
```
:WBFM:DEVN 500000.0;AC;ON
```

PULSE MODULATION

PULSE [not used alone]
:ON Turn Pulse modulation ON
:OFF Turn Pulse modulation OFF

Data type : None
Allowed suffices : None
Default suffix : None

Examples:
```
PULSE:ON
PULSE:OFF
```

PULSE? Prepares message containing information on Pulse Modulation setting in the following format:

:PULSE:<status>

where: <status> is a program mnemonic indicating whether the modulation is ON or OFF

Examples:
```
:PULSE:ON
:PULSE:OFF
```

MODULATION FREQUENCY

INTF1 or INTF2 or INTF3 or INTF4 or INTF5 or INTF6 Set modulation oscillator frequency (short form)

:FREQ Set modulation oscillator frequency

:INC Set modulation oscillator frequency step size

Data type : Decimal Numeric Program Data
Allowed suffices : Any one of: GHZ, MHZ, KHZ or HZ
Default suffix : HZ

:SIN Select sinusoidal waveform

:TRI Select triangle wave

:UP Go UP one step

:DN Go DOWN one step

:RETN Return to original setting

:XFER Transfer current value to be the new setting

Data type : None
Allowed suffices : None
Default suffix : None

:PHASE Adjust Phase of Modulation Oscillator

Data type : Decimal Numeric Program Data
Allowed suffices : DEG
Default suffix : DEG

:CTC1 Select tone number (0 to 15) from Continuous Tone Group 1

:CTC2 Select tone number (0 to 15) from Continuous Tone Group 2

:USER Select tone number (0 to 15) from Continuous Tone USER group

:TEMP Select tone number (0 to 15) from Continuous Tone TEMP group

Data type : Decimal Numeric Program Data
Allowed suffices : None
Default suffix : None

Examples:

```
INTF1:FREQ 1.5KHZ;SIN
INTF1:CTC1 3
```

INTF1, etc. (continued)

INTF1? or INTF2? or INTF3? or INTF4? or INTF5? or INTF6?

Prepares message containing information on modulation oscillator setting in one of the following formats:

:INTF1:FREQ <nr2>;INC <nr2>;<waveform>
:INTF6:<standard> <nr1>

where: <waveform> is a program mnemonic (SIN or TRI) indicating the waveform shape and <standard> is a program mnemonic (CTC1, CTC2, USER or TEMP) indicating the continuous tone signalling standard selected.

Examples:
```
:INTF2:FREQ 440.0;INC 100.0;SIN
:INTF3:CTC1 5
```

CTCSS TONES EDIT

CTONES [not used alone]

:EDIT [not used alone]

:TNUM Select tone number 0-15

Data type : Decimal Numeric Program Data
Allowed suffices : None
Default suffix : None

:TFRQ Set tone frequency

Data type : Decimal Numeric Program Data
Allowed suffices : Any one of: GHZ, MHZ, KHZ or HZ
Default suffix : HZ

:LOAD Copy Standard to TEMP for editing

Data type : Character Program Data (any one of: CTC1, CTC2 or USER)
Allowed suffices : None
Default suffix : None

:SAVE Save TEMP to USER after editing for non-volatile storage (if required)

Data type : None
Allowed suffices : None
Default suffix : None

CTONES? [not used alone]

CTONES:EDIT? Prepares message containing information on the current tone number being edited and its frequency in the following format:

:CTONES:EDIT:TNUM <nr1>;TFREQ <nr2>

Example: `:CTONES:EDIT;TNUM 5;TFREQ 202.8`

SEQUENTIAL TONES

SEQT — [not used alone]

:SEQ — Set Tone sequence

Data type : String Program Data consisting of up to 16 characters from 0 to 9 and A to F between string delimiters (eg. "123C5" or '123C5'). For DTMF E and F are not allowed and are replaced by * and #.
Allowed suffices : None
Default suffix : None

:DUR — Set Duration Mask

Data type : String Program Data consisting of up to 15 characters "-" or "E" between string delimiters (eg. "---E-" or '---E-')
Allowed suffices : None
Default suffix : None

:SEND — Send Sequence *n* times where *n* has the value 1 to 9 indicating the number of tone sequences to be sent.

Data type : Decimal Numeric Program Data
Allowed suffices : None
Default suffix : None

:STOP — Stop sending sequence.

Data type : None
Allowed suffices : None
Default suffix : None

:MODE — [not used alone]

:STD — Select Tones standard

Data type : Character Program Data (any one of: CCIR, EURO, DZVEI, ZVEI1, ZVEI2, EEA, EIA, NATEL, TEMP, USER1, USER2 or DTMF).
Allowed suffices : None
Default suffix : None

:MOD — Select Modulation Channel

Data type : Character Program Data (any one of: AM1, AM2, FM1, FM2, PM1, PM2, TOTAL_AM, TOTAL_FM, TOTAL_PM or NO_TONES)
Allowed suffices : None
Default suffix : None

SEQT (continued)

:PARAM [not used alone]
:EXTD Set the duration of the Extended tone.
:SDLY Set Starting Delay

Data type : Decimal Numeric Program Data
Allowed suffices : MS
Default suffix : MS

:SHFT Set Frequency Shift (up to ±10.0%)

Data type : Decimal Numeric Program Data
Allowed suffices : PCT
Default suffix : PCT

:RPTT Select Repeat Tone

Data type : String Program Data (any one of 0 to 9 or A to F between strings delimiters (eg. "E" or 'E').
Allowed suffices : None
Default suffix : None

:TDUR Set DTMF Tone duration
:TGAP Set DTMF inter-element gap

Data type : Decimal Numeric Program Data
Allowed suffices : MS
Default suffix : MS

:EDIT [not used alone]
:TNUM Select Number of Tone to Edit

Data type : Decimal Numeric Program Data
Allowed suffices : None
Default suffix : None

:TFRQ Set Tone Frequency of tone selected by TNUM

Data type : Decimal Numeric Program Data
Allowed suffices : Any one of: GHZ, MHZ, KHZ or HZ
Default suffix : HZ

:TDUR Set Normal Tone Duration
:TGAP Set Inter-element Gap

Data type : Decimal Numeric Program Data
Allowed suffices : MS
Default suffix : MS

:LOAD Load a Standard to TEMP for editing

Data type : Character Program Data (any one of: CCIR, EURO, DZVEI, ZVEI1, ZVEI2, EEA, EIA, NATEL, USER1 or USER2)
Allowed suffices : None
Default suffix : None

SEQT:EDIT (continued)

:SAVE Copy TEMP to USER1 or USER2

Data type : Character Program Data (either USER1 or USER2)
Allowed suffices : None
Default suffix : None

Examples:
```
SEQT:SEQ "12245B7";DUR "----E--"
SEQT:MODE STD CCIR;MOD TOTAL FM
SEQT:PARAM:EXTD 200MS;SHFT 0.5PCT
SEQT:EDIT:TNUM 3;TFRQ 1342.7HZ;SAVE USER1
```

SEQT? Prepares message containing information on the signalling sequence and duration settings in the following format:

:SEQT:SEQ <toneseq>;DUR <durseq>

where: <toneseq> is string program data defining the tone sequence and <durseq> is string program data defining the duration sequence.

Examples:
```
:SEQT:SEQ "12245B7";DUR "----E--"
:SEQT:SEQ "12345*#9"          (DTMF ONLY)
```

SEQT:MODE? Prepares message containing information on the signalling standard and the modulation channel selected in the following format:

:SEQT:MODE:STD <standard>;MOD <modchannel>

where: <standard> is a program mnemonic defining the tone standard and <modchannel> is character program data defining the modulation channel allocated to tone signalling.

Example:
```
:SEQT:MODE:STD ZVEI;MOD TOTAL FM
```

SEQT:PARAM? Prepares message containing information on signalling parameter settings in the following format:

:SEQT:PARAM:EXTD <nr1>;SHFT <nr2>;RPTT <rpt>;SDLY <nr1>

where: <rpt> is string program data defining the tone number used to represent the repeat tone.

Examples:
```
:SEQT:PARAM:EXTD 200;SHFT -1.6;RPTT "E";SDLY 300
:SEQT:PARAM:SDLY 30;TDUR 100;TGAP 75        (DTMF ONLY)
```

SEQT:EDIT?

Prepares message containing information on signalling editing in the following format:

:SEQT:EDIT:TNUM <nr1>;TFREQ <nr2>;TDUR <nr1>;TGAP <nr1>

Example:

```
:SEQT:EDIT:TNUM 3;TFREQ 1342.7;TDUR 40;TGAP 0
```

LF CONTROL

LF — [not used alone]

:ON — Turn LF output ON

:OFF — Turn LF output OFF

:GEN — Select LF Generator

Data type : None
Allowed suffices : None
Default suffix : None

:MON — Select source monitor mode

Data type : Character Program Data (any one of: AM1S, AM2S, AMD, ANG1S, ANG2S, ANGD or OFF, where AM represents Amplitude Modulation, ANG represents Angular Modulation, the suffix 'S' indicates Source and 'D' indicates Drive)
Allowed suffices : None
Default suffix : None

Examples:

```
LF:MON FM;ON
LF:MON ANGD
LF:GEN
```

LF? — Prepares message containing information on the LF operation in one of the following formats depending on which LF mode is currently in use:

:LF:GEN;<status>
:LF:MON <source>;<status>

where: <source> is character program data representing the source being monitored and <status> is a program mnemonic indicating whether the output is ON or OFF.

Examples:

```
:LF:GEN;ON
:LF:MON AM1S;OFF
```

LF GENERATOR FREQUENCY

LFGF		Set LF Generator frequency (short form)
	:VALUE	Set LF Generator frequency
	:INC	Set LF Generator frequency step
	Data type :	Decimal Numeric Program Data
	Allowed suffices :	Any one of: GHZ, MHZ, KHZ or HZ
	Default suffix :	HZ
	:UP	Go UP one step
	:DN	Go DOWN one step
	:RETN	Return to original setting
	:XFER	Transfer current value to be the new setting
	:SIN	Select sinusoidal waveform
	:TRI	Select triangle wave
	Data type :	None
	Allowed suffices :	None
	Default suffix :	None

Example: `LFGF:VALUE 25KHZ;INC 500HZ`

LFGF? Prepares message containing information on LF Generator Frequency setting in the following format:

:LFGF:VALUE <nr2>;INC <nr2>

Example: `:LFGF:VALUE 25067.8;INC 500.0`

LF GENERATOR LEVEL

LFGL Set LF Generator level (short form)

:VALUE Set LF Generator level

Data type : Decimal Numeric Program Data
Allowed suffices : V, MV, UV
Default suffix : V

:INC Set LF Generator level step

Data type : Decimal Numeric Program Data
Allowed suffices : DB
Default suffix : DB

:UP Go UP one step
:DN Go DOWN one step
:RETN Return to original setting
:XFER Transfer current value to be the new setting

Data type : None
Allowed suffices : None
Default suffix : None

Examples:
```
LFGL:VALUE 75.6MV;INC 20DB
LFGL:UP
```

LFGL? Prepares message containing information on LF Generator Level setting in the following format:

:LFGL:VALUE <nr2>;INC <nr2>

Example:
```
:LFGL:VALUE 125.8;INC 1.0
```

MEMORY - STORE

STO	[not used alone]
:FULL	Full Store 0-49
:PART	Partial Store 0-49
:CFRQ	Carrier Freq Store 0-99
:SEQT	Sequential Tones Store 0-19
:SWEEP	Sweep Store 0-19

Data type : Decimal Numeric Program Data
Allowed suffices : None
Default suffix : None

Examples:
```
:STO:FULL 17
:STO:CFRQ 83
```

MEMORY - RECALL

RCL	[not used alone]
:FULL	Recall Full 0-49
:FXCF	Recall Full 0-49 (without carrier frequency)
:PART	Recall Partial 0-49
:RXCF	Recall Partial 0-49 (without carrier frequency)
:CFRQ	Recall Carrier Freq 0-99
:SEQT	Recall Sequential Tones Sequence 0-19
:SWEEP	Recall Sweep 0-19

Data type : Decimal Numeric Program Data
Allowed suffices : None
Default suffix : None

Examples:
```
:RCL:FULL 15
:RCL:CFRQ 75
```

MEMORY - ERASE

ERASE	[not used alone]
:FULL	Erase all Full Stores
:PART	Erase all Partial Stores
:CFRQ	Erase all Carrier Freq Stores
:SEQT	Erase all Sequential Tones Stores
:SWEEP	Erase all Sweep Stores
:ALL	Erase all Stores

Data type : None
Allowed suffices : None
Default suffix : None

Examples:
```
:ERASE:FULL 12
:ERASE:ALL
```

SWEEP OPERATION

IMODE — Select Instrument Mode

Data type : Character Program Data (either NORMAL for signal generator operation or SWEEPER for swept operation)
Allowed suffices : None
Default suffix : None

Example:
```
IMODE SWEEPER
```

SWEEP — [not used alone]

:MKRON — Enable Sweep Markers
:MKROFF — Disable sweep Markers

Data type : None
Allowed suffices : None
Default suffix : None

Examples:
```
SWEEP:CFRQ:START 75MHZ;STOP 150MHZ;STEP 100;TIME 10MS
SWEEP:RFLV:START -56DBM;STOP -12DBM;STEP 440;TIME 25MS
SWEEP:CFRQ:MKRNUM 1;VALUE 83MHZ;MKRON
```

:CFRQ — [not used alone]
:<cmd> — Select Carrier Frequency sweep parameter entry where <cmd> is replaced by one of the commands (START, STOP, STEP, TIME, MKRNUM, MKRON, MKROFF or VALUE)

:RFLV — [not used alone]
:<cmd> — Select RF Level sweep parameter entry where <cmd> is replaced by one of the commands (START, STOP, STEP, TIME, MKRNUM, MKRON, MKROFF or VALUE)

:LFGF — [not used alone]
:<cmd> — Select LF Generator Frequency sweep parameter entry where <cmd> is replaced by one of the commands (START, STOP, STEP, TIME, MKRNUM, MKRON, MKROFF or VALUE)

:LFGL — [not used alone]
:<cmd> — Select LF Generator Level sweep parameter entry where <cmd> is replaced by one of the commands (START, STOP, STEP, TIME, MKRNUM, MKRON, MKROFF or VALUE)

:INTF — [not used alone]
:<cmd> — Select Internal Modulation Oscillator Frequency sweep parameter entry where <cmd> is replaced by one of the commands (START, STOP, STEP, TIME, MKRNUM, MKRON, MKROFF or VALUE)

HOP — [not used alone]
:<cmd> — Select Frequency Hopping sweep parameter entry where <cmd> is replaced by TIME.

SWEEP (continued)

:START Select start value of the parameter to be swept.
:STOP Select stop value of the parameter to be swept.

Data type : As used for the parameter
Allowed suffices : As used for the parameter
Default suffix : As used for the parameter

:STEP Select number of steps in the sweep.

Data type : Decimal Numeric Program Data
Allowed suffices : None
Default suffix : None

:TIME Select time per sweep step

Data type : Decimal Numeric Program Data
Allowed suffices : MS
Default suffix : MS

:MKRNUM Select marker

Data type : Decimal Numeric Program Data
Allowed suffices : None
Default suffix : None

:MKROFF Turn Current Marker OFF
:MKRON Turn Current Marker ON

Data type : None
Allowed suffices : None
Default suffix : None

:VALUE Set Value of Current Marker

Data type : Decimal Numeric Program Data
Allowed suffices : As used for the parameter
Default suffix : As used for the parameter

SWEEP? Prepares message containing information on Sweep Mode, Type and Marker status in the following format:

:SWEEP:MODE <mode>;TYPE <type>;<status>

where: <mode> is a program mnemonic representing the sweep mode selected, <type> is a program mnemonic representing the sweep type selected and <status> is a program mnemonic indicating whether the Marker output is ON or OFF.

Sample responses:
```
:SWEEP:MODE CONT;TYPE CFRQ;MKROFF
:SWEEP:TYPE HOP:MODE SNGL
```

SWEEP? (continued)

:CFRQ?

Prepares message containing information on Carrier Frequency Sweep settings in the following format:

:SWEEP:START <nr2>;STOP <nr2>;STEP <nr1>;TIME <nr1>;
MKRNUM <nr1>;<status>;VALUE <nr2>

where: <status> is a program mnemonic indicating whether the selected Marker is ON or OFF.

Sample response:

```
:SWEEP:START 1230000.0;STOP 1330000.0;STEP 100;
TIME 20;MKRNUM 2;MKRON;VALUE 1240000.0
```

:RFLV?

Prepares message containing information on RF Level Sweep settings in the following format:

:SWEEP:START <nr2>;STOP <nr2>;STEP <nr1>;TIME <nr1>;
MKRNUM <nr1>;<status>;VALUE <nr2>

where: <status> is a program mnemonic indicating whether the selected Marker is ON or OFF.

Sample response:

```
:SWEEP:START -107.0;STOP -27.0;STEP 80;TIME 50;
MKRNUM 2;MKRON;VALUE -97.0
```

:LFGF?

Prepares message containing information on LF Generator Frequency Sweep settings in the following format:

:SWEEP:START <nr2>;STOP <nr2>;STEP <nr1>;TIME <nr1>;
MKRNUM <nr1>;<status>;VALUE <nr2>

where: <status> is a program mnemonic indicating whether the selected Marker is ON or OFF.

Sample response:

```
:SWEEP:START 300.0;STOP 3000.0;STEP 2700;TIME 1;
MKRNUM 1;MKRON;VALUE 400.0
```

SWEEP? (continued)

:LFGL? Prepares message containing information on LF Generator Level Sweep settings in the following format:

:SWEEP:LFGL:START <nr2>;STOP <nr2>;STEP <nr1>;TIME <nr1>; MKRNUM <nr1>;<status>;VALUE <nr2>

where: <status> is a program mnemonic indicating whether the selected Marker is ON or OFF.

Sample response:
```
:SWEEP:LFGL:START 1.0;STOP 120.0;STEP 120;TIME 10;
MKRNUM 2;MKRON;VALUE 5.0
```

:INTF? Prepares message containing information on Modulation Oscillator Frequency Sweep settings in the following format:

:SWEEP:INTF:START <nr2>;STOP <nr2>;STEP <nr1>;TIME <nr1>; MKRNUM <nr1>;<status>;VALUE <nr2>

where: <status> is a program mnemonic indicating whether the selected Marker is ON or OFF.

Sample response:
```
:SWEEP:INTF:START 270.0;STOP 3300.0;STEP 500;TIME 1;
MKRNUM 4;MKRON;VALUE 2900.0
```

:HOP? Prepares message containing information on Frequency Hopping Sweep in the following format:

:SWEEP:HOP:TIME<nr1>

SWEEP MODE/TYPE

SWEEP [not used alone]

:MODE Select Mode of operation for Sweep generator (single shot, continuous or externally triggered)

Data type : Character Program Data (any one of SNGL, CONT or EXT)
Allowed suffices : None
Default suffix : None

SWEEP (continued)

:TYPE Select Type of Sweep (Carrier Frequency, RF Level, LF Generator Frequency, LF Generator Level, Internal Modulation Oscillator Frequency or Off)

Data type : Character Program Data (any one of: OFF, CFRQ, RFLV, LFGF, LFGL, INTF1, INTF2, INTF3, INTF4, INTF5, INTF6, HOP or OFF)
Allowed suffices : None
Default suffix : None

Examples:
```
:SWEEP:MODE SNGL;TYPE CFRQ
:SWEEP:MODE CONT;TYPE INTF4
```

SWEEP? Prepares message containing information on Sweep Mode, Type and Marker status in the following format:

:SWEEP:MODE <mode>;TYPE <type>;<status>

where: <mode> is a program mnemonic representing the sweep mode selected, <Type> is a program mnemonic representing the sweep type selected and <status> is a program mnemonic indicating whether the Marker output is ON or OFF.

Examples:
```
:SWEEP:MODE CONT;TYPE CFRQ;MKROFF
:SWEEP:TYPE HOP:MODE SNGL
```

SWEEP CONTROL

SWEEP	[not used alone]
:GO	Commence Sweep
:CALC	Initiate Pre-calculation
:HALT	Pause Sweep
:CONT	Continue Sweep
:RESET	Reset sweep to Start Value
:XFER	Transfer Paused Value to Main Parameter
:UP	Go UP one sweep step while paused
:DN	Go DOWN one sweep step while paused

Data type : None
Allowed suffices : None
Default suffix : None

Examples:
```
SWEEP:GO
SWEEP:RESET
```

FREQUENCY HOPPING

HOPSEQ Enter frequency hopping sequence

Data type : Decimal Numeric Program data (can be multiple)
Allowed suffices : None
Default suffix : None

Examples:
```
HOPSEQ 56, 72, 0, 4, 99, 72
HOPSEQ 255, 0, 4, 17, 23, 64, 72
```

HOPSEQ? Returns a value 0-1024 indicating the number of steps in the Frequency Hopping Sequence.

MISCELLANEOUS COMMANDS

IMODE Select Instrument Mode

Data type : Character Program Data (either NORMAL for signal generator operation or SWEEPER for swept operation)
Allowed suffices : None
Default suffix : None

RPPR Reset reverse power protection trip

Data type : None
Allowed suffices : None
Default suffix : None

FSTD Select internal or external frequency standard

Data type : Character program data (any one of INT1, INT5, INT10, EXT1, EXT5 or EXT10)
Allowed suffices : None
Default suffix : None

Examples:
```
INT10
EXT5
```

FSTD? Prepares message containing information on frequency standard selection in the format:

:FSTD <char>

Example:
```
:FSTD EXT10
```

BLANK Blank or unblank various parts of the display. The number sent after the command determines the action to be taken as follows:

0 blank or unblank the Carrier Frequency display
1 blank or unblank the RF Level display
2 blank or unblank the Modulation Frequency display
3 blank or unblank the Modulation display
4 blank all displays

Data type : Decimal Numeric Program Data (any one of 0, 1, 2, 3 or 4)
Allowed suffices : None
Default suffix : None

Examples:
```
BLANK 0
BLANK 4
```

BACKL [not used alone]
:ON Backlighting On
:OFF Backlighting Off

Data type : None
Allowed suffices : None
Default suffix : None

Examples:
```
BACKL:ON
BACKL:OFF
```

TIME? Prepares message containing information on current real time clock time setting in the format:

<HH:MM>

where: <HH:MM> is string program data representing the time in hours and minutes using the 24 hour clock notation.

Example:
```
"17:55"
```

DATE? Prepares message containing information on current real time clock date setting in the format:

<YYYY-MM-DD>

where: <YYYY-MM-DD> is string program data representing the date in ISO notation (year number, month number, day number).

Example:
```
"1990-04-01"
```

OPER? Prepares message containing information on total operating hours in the following format:

<nr2>

Example:
```
1453.0
```

ELAPSED? Prepares message containing information on elapsed operating hours since last reset in the following format:

<nr2>

Example:
```
454.5
```

ERROR?

Prepares message containing the number of the next error in the error queue in the following format:

<nr1>

The numeric value returned is either that of the next error number or 0 if the queue is empty or 255 if the queue is full

Example: `37`

DEFTRG

Set Device Trigger Function (action on receipt of *TRG)

Data type : Character Program Data (any one of: SEQT, FLSWP, SSSWP or VOID)
Allowed suffices : None
Default suffix : None

EXTTRG

Set External Trigger Function (action on Low signal being applied to External Trigger Socket).

Data type : Character Program Data (any one of: SEQT, FLSWP, SSSWP, MEMUP, MEMDN or VOID)
Allowed suffices : None
Default suffix : None

Examples:
```
DEFTRG SEQT
EXTTRG MEMUP
```

KLOCK

Disables keyboard entry except RPP Reset and Go to Local

Data type : None
Allowed suffices : None
Default suffix : None

KUNLOCK

Enables keyboard entry

Data type : None
Allowed suffices : None
Default suffix : None

THE STATUS BYTE

The Status Byte provides information about events and conditions within the instrument. It may be read by a conventional Serial Poll or its value obtained as a response to the *STB? query. Bits 0 to 5 and bit 7 are each single bit Summary Messages which may be of two types (or not used at all).

(i) Query Status - a '1' indicates that an associated Queue is non-empty and has data available to be read.

(ii) Status Register Summary - reports the occurrence of an enabled event monitored by a Status Register Structure.

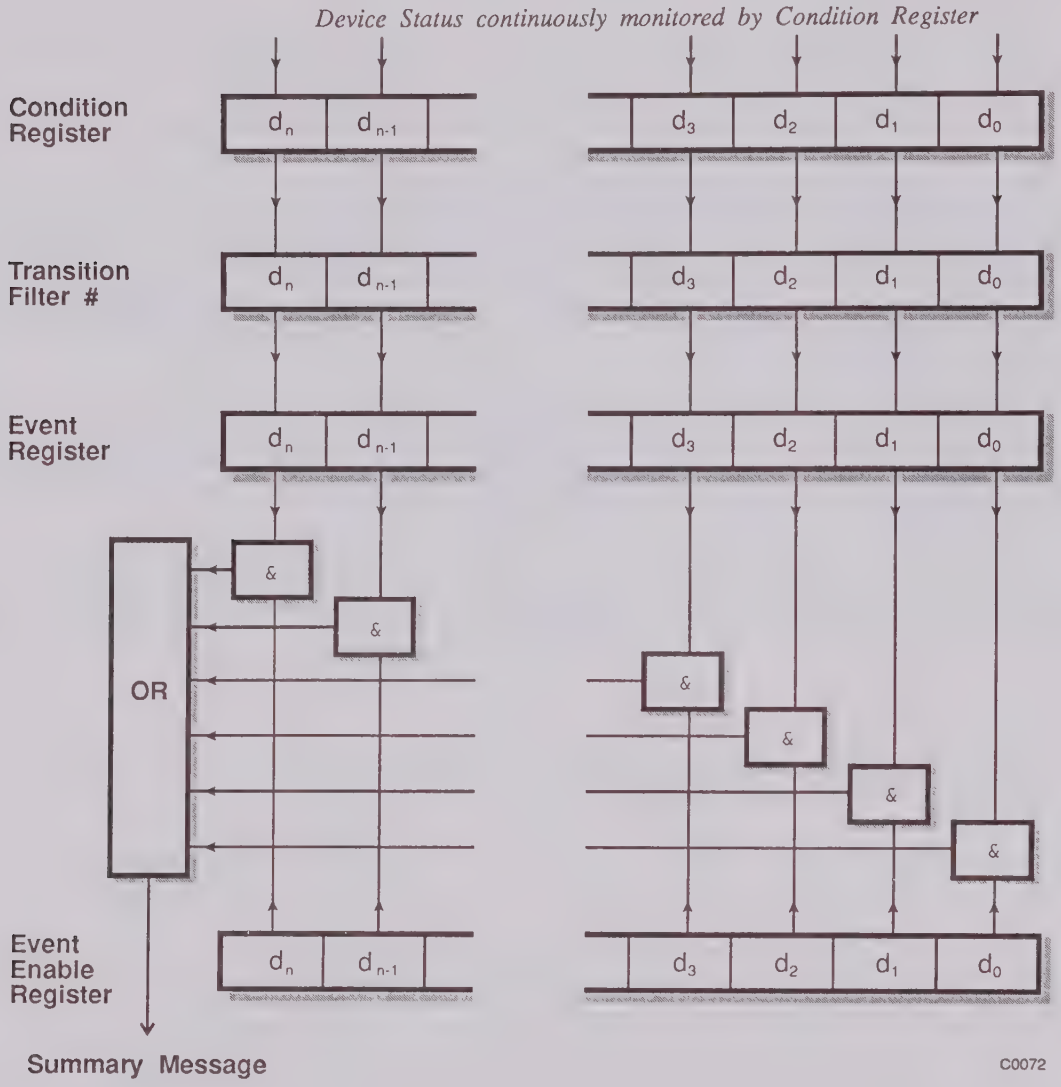
The Service Request Enable Register determines which of the bits can generate an SRQ, this register may be set by *SRE or read by *SRE?. If the bitwise -AND of the Status Byte and the Enable Register is non-zero the Flag Master Summary Status (<mss>) is True. Bit 6 of the Status byte value read by *STB? holds <mss>. However bit 6 of the Status Byte when Serial Polled is the Request For Service bit used to determine which device on the Bus has asserted SRQ, and is cleared by a Serial Poll.

The IEEE 488.2 Standard defines bit 4 as Message Available (<mav>), the Queue Summary for the Output Buffer, indicating whether any part of a Response Messages is available to be read. Bit 5 is the Event Summary Bit (<esb>), the Summary Message from the Standard Event Status Register.

In 2030 series, bit 7 is a Queue Summary for the Error Queue. Bits 1, 2, and 3 are Status summaries for the Instrument Status, Coupling Status and Hardware Status Registers. Bit 0 is unused.

STATUS DATA STRUCTURE - REGISTER MODEL

Below is a generalised model of the Register Set which funnels the monitored data into a single summary bit to set the appropriate bit in the Status Byte.



Notes...

The Device Status is continuously monitored by the Condition Register. If a Query to read a Condition Register is provided, the Response represents the Status of the instrument at the moment the Response is generated. A Condition Register cannot be written to.

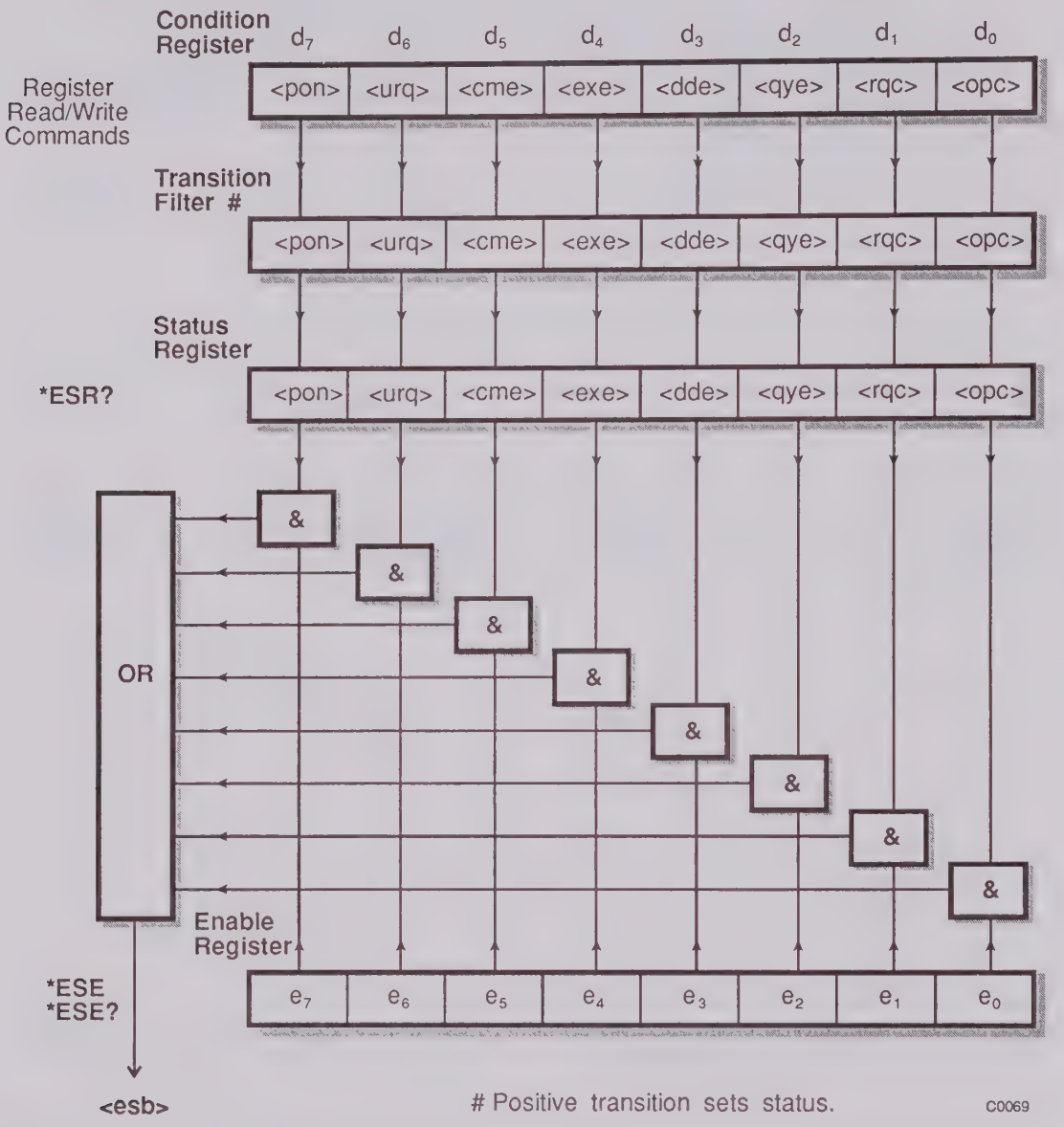
The Transition Filter determines which transition of the Condition Register data bits will set the corresponding bit in the Event Register. Either positive-going, negative-going or both transitions can set bits in an Event Register. But in the 2030 series the Transition Filters are pre-set as either Positive or Negative, as described in the following pages.

The bits in an Event Register are "latched". Once set they remain set, regardless of subsequent changes in the associated condition bit until the Event Register is cleared by being read or by the *CLS common command. Once cleared, an Event Register bit will only be set again if the appropriate change in the Condition bit occurs.

The Event Enable Register may be both written to and read from. It is bitwise AND-ed with the Event Register and if the result is non-zero the Summary Message is true, otherwise the Summary Message is false. Enable Registers are not affected by *CLS but are however clear at power-on.

STANDARD EVENT REGISTERS

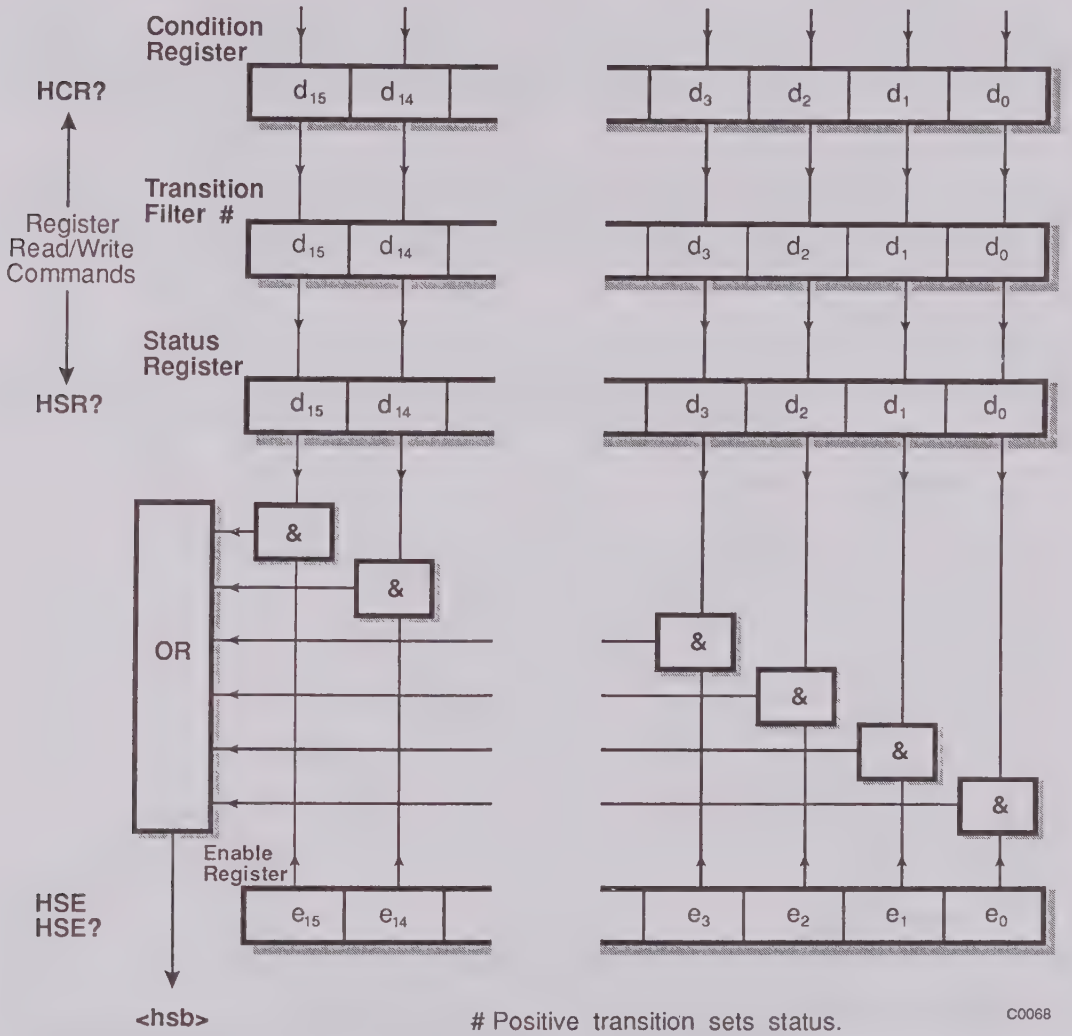
This Register is defined by IEEE 488.2 and each bit has the meaning shown below:-



<pon>	power on
<urq>	user request - not implemented in this product
<cme>	command error
<exe>	execution error
<dde>	device dependent error
<qye>	query error
<rqc>	request control - not implemented in this product
<opc>	operation complete - set in response to the *OPC command for synchronisation.
<esb>	standard event register summary bit

HARDWARE EVENT REGISTERS

This is a device dependant Register and the bits have meanings as shown in the list at the bottom of the page.

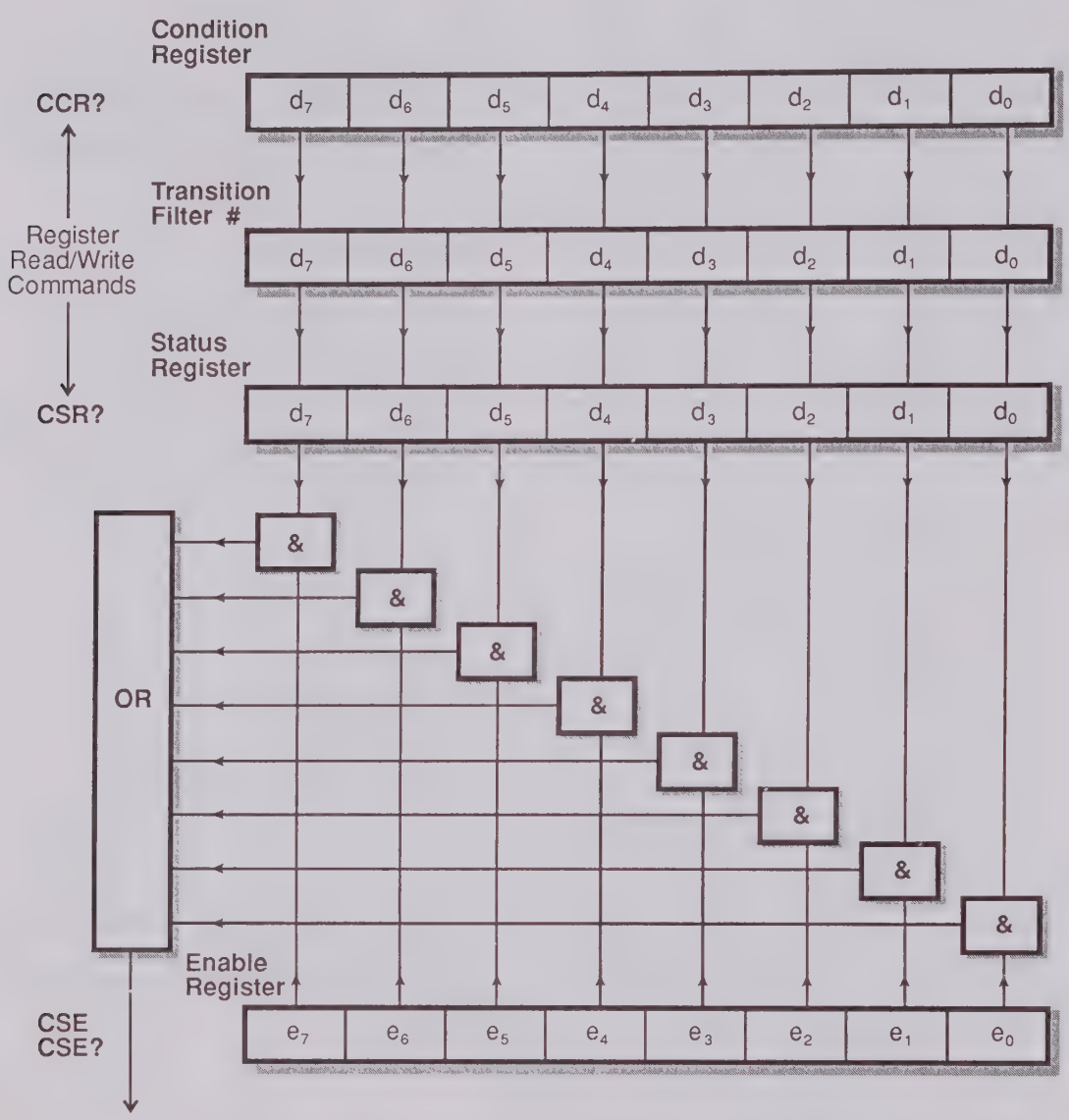


d_0	reverse power protection tripped	d_8	not used
d_1	fractional-n system out-of-lock	d_9	not used
d_2	vcxo out-of-lock	d_{10}	not used
d_3	frequency standard missing	d_{11}	not used
d_4	external mod 1 alc loop signal too low	d_{12}	not used
d_5	external mod 1 alc loop signal too high	d_{13}	not used
d_6	external mod 2 alc loop signal too low	d_{14}	not used
d_7	external mod 2 alc loop signal too high	d_{15}	not used

<hsb> hardware event register summary bit

COUPLING EVENT REGISTERS

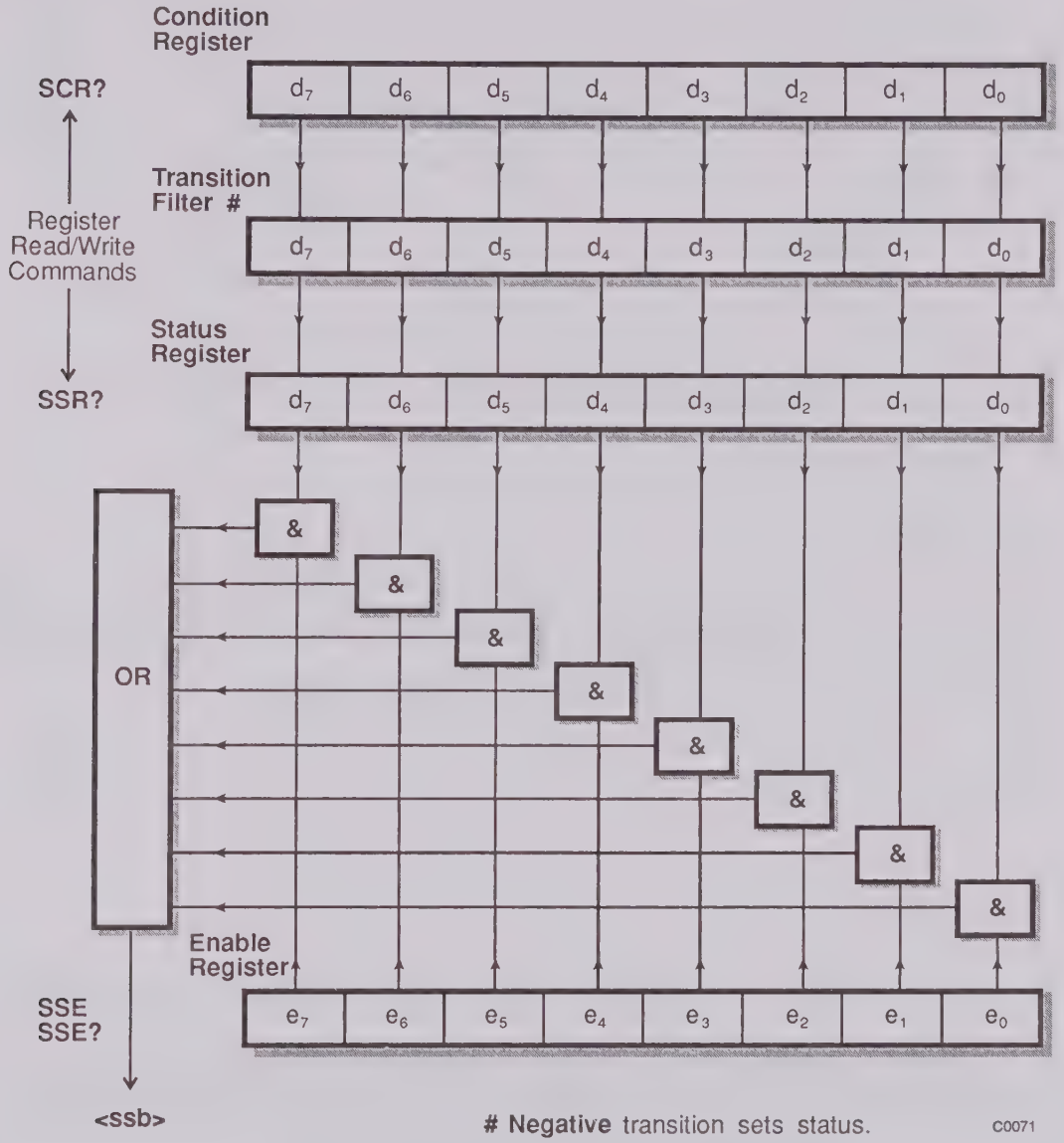
This is a device dependant Register and the bits have meanings as shown in the list at the bottom of the page.



d_0	am restricted by requested rf level
d_1	fm restricted by requested carrier frequency
d_2	widebandfm restricted by requested carrier frequency
d_3	am2 depth restricted by requested am1 depth
d_4	fm2 deviation restricted by requested fm1 deviation
d_5	pm2 deviation restricted by requested pm1 deviation
d_6	number of sweep steps restricted by other parameters
d_7	not used
<csb>	coupling event register summary bit

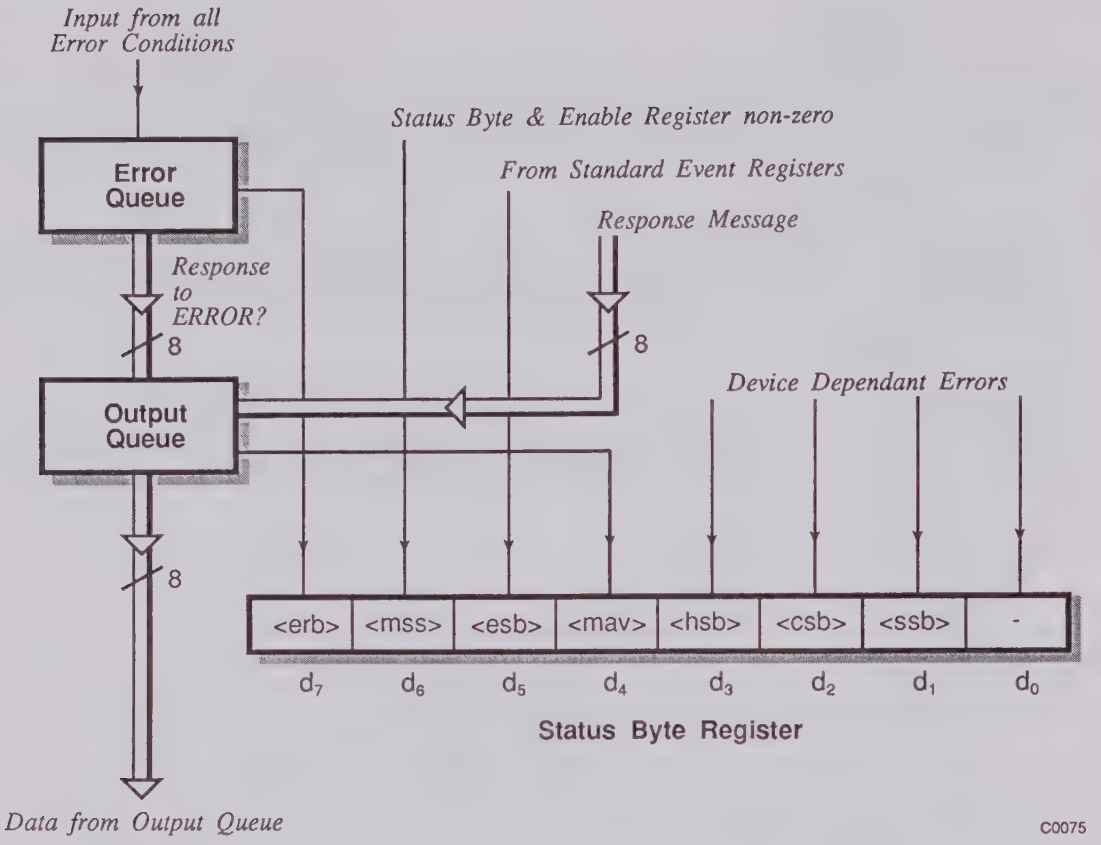
INSTRUMENT EVENT REGISTERS

This is a device dependant Register and the bits have meanings as shown in the list at the bottom of the page.



	Condition (*SCR?)	Event Status (*SSR?)
d_0	sweep in progress	end of sweep
d_1	sending tones	tones sent
d_2	selfcal in progress	selfcal completed
d_3	dc fm null in progress	dc fm null completed
d_4	not used	not used
d_5	not used	not used
d_6	not used	not used
d_7	not used	not used
<ssb>	instrument event register summary bit	

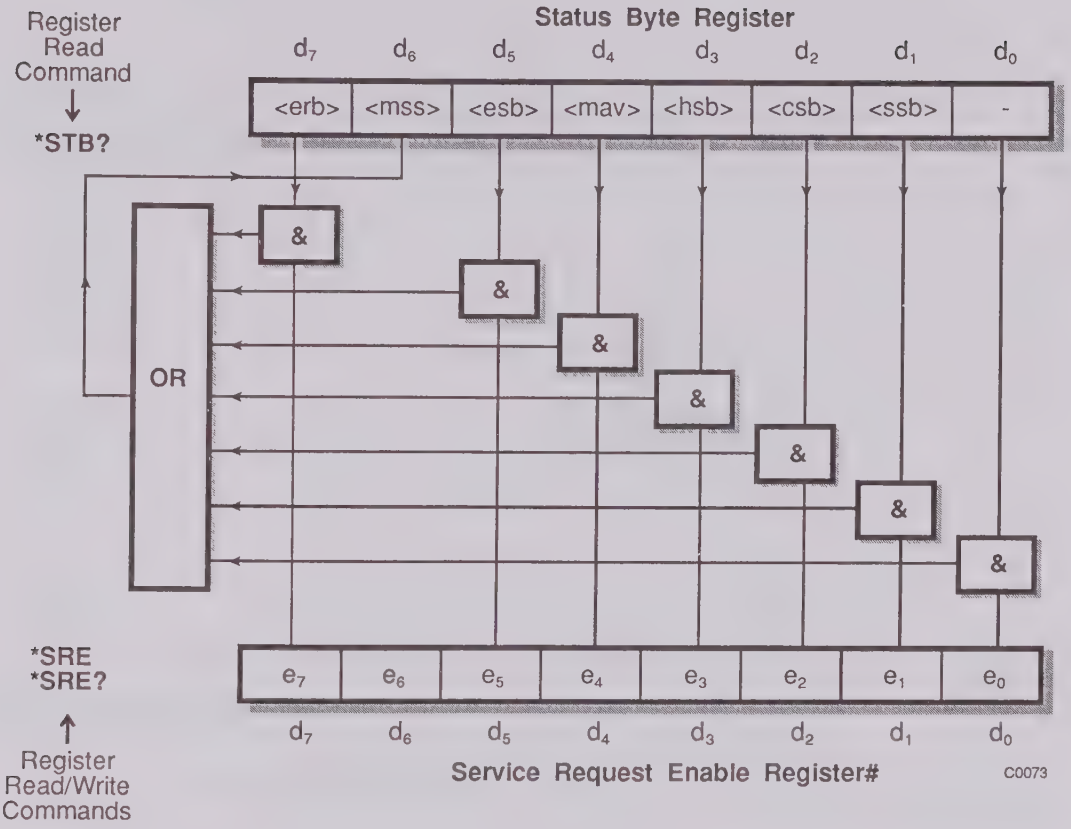
QUEUE FLAG DETAILS



The <mav> status bit is set when one or more bytes are available to be read from the Output Queue.

The <erb> status bit is set when one or more errors are present in the Error Queue. The ERROR? query will place a nr1 response message in the Output Queue representing the Error at the head of the queue, if the queue is empty then this message will be 0.

STATUS BYTE WHEN READ BY *STB?



Bit 6 in this register ignores data sent by ***SRE** and always returns 0 in response to ***SRE?**

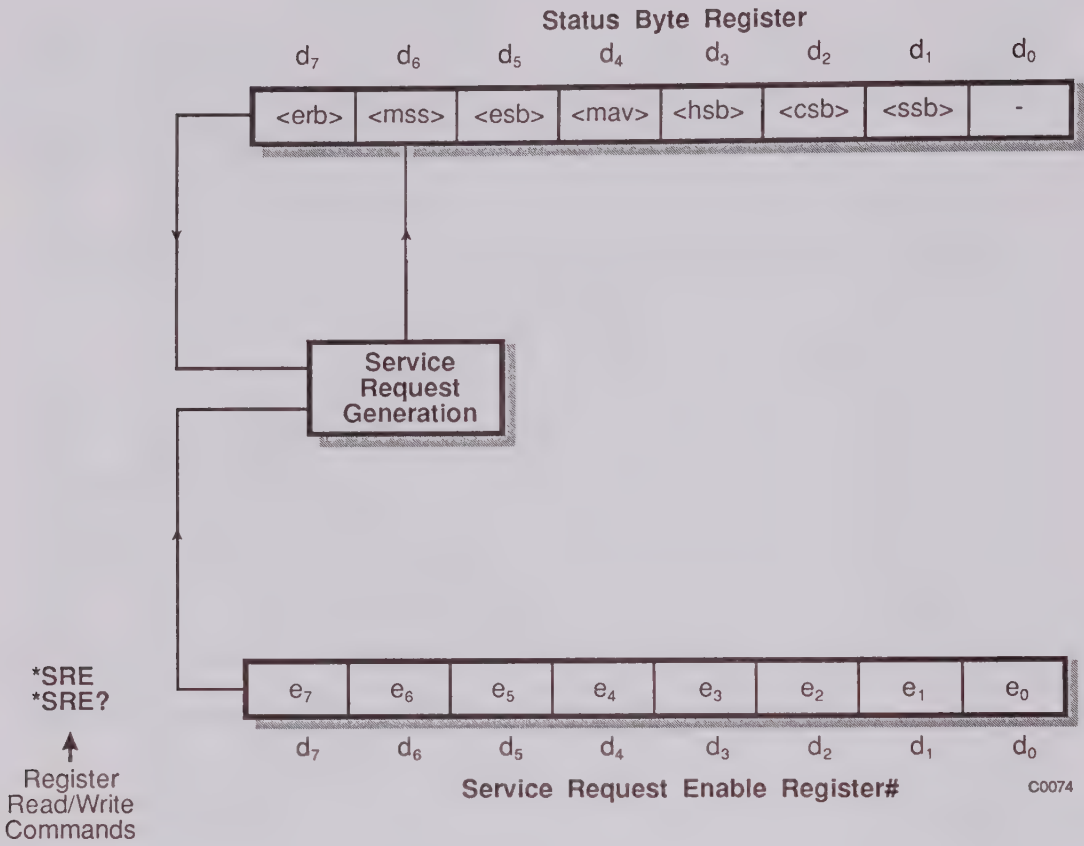
<rqs>, <esb> and <mav> are defined in IEEE 488.2

<erb> is a device defined queue summary bit indicating that the error queue is non-empty.
<mss> is true when (Status Byte) AND (Enable register) > 0.
<esb> is the standard event register summary bit.
<mav> is 'message available' indicating that the output queue is non-empty.
<hsb> is 'hardware status' summary bit
<csb> is 'coupling status' summary bit
<ssb> is 'instrument status' summary bit

Note...

The Status Byte Register is Not cleared by the *STB? query.

STATUS BYTE WHEN READ BY SERIAL POLL



Bit 6 in this register ignores data sent by ***SRE** and always returns 0 in response to ***SRE?**

<erb> is a device defined queue summary bit indicating that the error queue is non-empty.
<rqs> is set by a request for service and is cleared by the poll.
<esb> is the standard event register summary bit.
<mav> is 'message available' indicating that the output queue is non-empty.
<hsb> is 'hardware status' summary bit
<csb> is 'coupling status' summary bit
<ssb> is 'instrument status' summary bit

<rqs>, <esb> and <mav> are defined in IEEE 488.2

<rqs> (request for service) will produce an SRQ at the controller. It is set by a change to either the Status Byte or the Service Enable Register that results in a New Reason for Service. It is cleared when <mss> goes FALSE (i.e. no reason for service) or by Serial Poll.

SUMMARY OF STATUS REPORTING COMMANDS AND QUERIES

*CLS	Clears Status Registers and the Error Queue
*ESE<nrf>	Writes to Standard Event Enable Register
*ESE?	Reads from Standard Event Enable Register
*ESR?	Reads from Standard Event Status Register
*SRE<nrf>	Writes to Service Request Enable Register
*SRE?	Reads from Service Request Enable Register
*STB?	Reads from Status Byte Register
CCR?	Reads from Coupling Condition Register
CSE<nrf>	Writes to Coupling Status Enable Register
CSE?	Reads from Coupling Status Enable Register
CSR?	Reads from Coupling Status Register
HCR?	Reads from Hardware Condition Register
HSE<nrf>	Writes to Hardware Status Enable Register
HSE?	Reads from Hardware Status Enable Register
HSR?	Reads from Hardware Status Register
SCR?	Reads from Instrument Condition Register
SSE<nrf>	Writes to Instrument State Enable Register
SSE?	Reads from Instrument State Enable Register
SSR?	Reads from Instrument State Status Register
<nrf>	Decimal Numeric Program Data

All of the above queries respond with a nr1 numeric format.

Chapter 4-1

BRIEF TECHNICAL DESCRIPTION

For details see over Page

INTRODUCTION

The 2030 series signal generators cover a wide range of frequencies from 10 kHz to 1.35 GHz (2030), 10 kHz to 2.7 GHz (2031) and 10 kHz to 5.4 GHz (2032). Output levels from -144 or -138 dBm to +13 dBm (+19 dBm on 2030 with Option 003 fitted) are available. The simplified block schematic diagram for the instrument is shown in Fig. 4-1.

MODULATION

The carrier frequency can be frequency, phase or amplitude modulated from internal or external modulation sources. A maximum of four modulation channels can be made available by the use of the internal oscillator and a second optional internal oscillator together with two external modulation signals applied to the EXT MOD 1 INPUT and EXT MOD 2 INPUT connectors on the front panel.

FREQUENCY GENERATION

Frequency generation is by means of an oven controlled 10 MHz crystal oscillator standard, a fractional n synthesizer system and four voltage controlled oscillators (VCOs) covering the range 675 to 1350 MHz. The complete frequency range is achieved by means of a beat frequency oscillator (BFO) a frequency doubler and quadrupler.

DISPLAY

The display is a high definition dot matrix liquid crystal panel with backlighting to cater for variations in ambient light conditions. The display can be adjusted for both contrast and brightness.

CONTROL

The 2030 series are menu driven instruments. Main menus are displayed by the use of hard keys, and parameters are changed by means of soft keys which change as the menu changes. Internal control of the instruments is achieved by a microprocessor which receives data from the various controls and sends instructions via an internal 8-bit data bus to the signal processing circuits.

The instruments can also be controlled by the built in general purpose interface bus (GPIB). This facility enables the instruments to be used both as manually operated bench mounted instruments or as part of a fully automated test system.

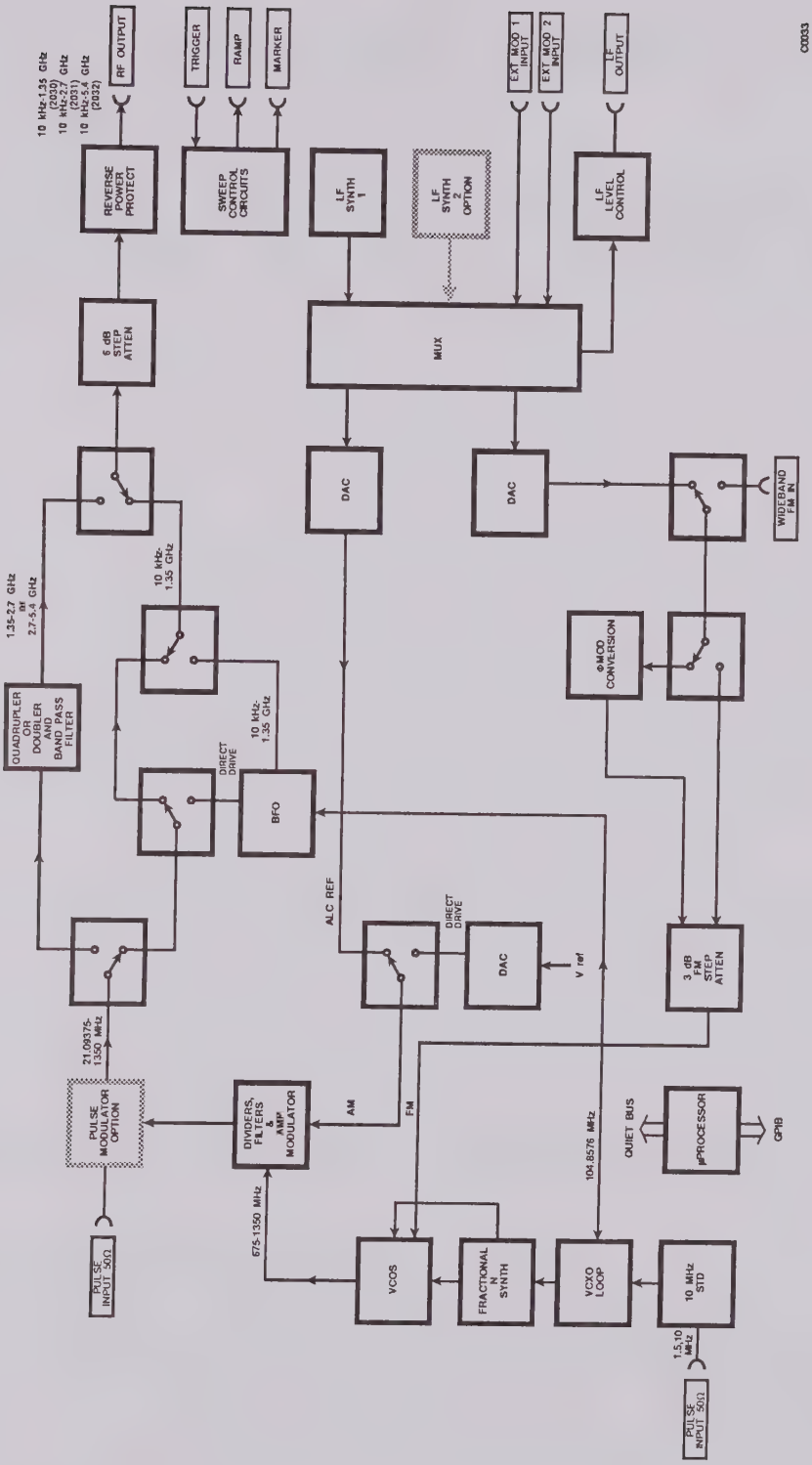


Fig. 4-1-1 Block schematic diagram

Chapter 5-1

ACCEPTANCE TESTING

INTRODUCTION

The test procedures in this chapter enable you to verify that the electrical performance of the signal generator complies with the Performance Data given in Chapter 1. The test equipment recommended for this purpose is listed in Table 5-1-1. All tests may be performed with the covers in place and are intended to be carried out in the order given. For convenience, the test equipment and specification for each test are summarized before the test procedure.

For those signal generators with options fitted, the appendixes at the end of this Chapter must be referred to.

TEST PRECAUTIONS

To ensure minimum errors and uncertainties when making measurements, it is important to observe the following precautions:-

(1) Always use recently calibrated test equipment, with any correction figures taken into account, so as to establish a known or traceable limit of performance uncertainty. This uncertainty must be allowed for in determining the accuracy of measurements. For example, if a parameter has a claimed accuracy of ±10% in the Performance Data, and you are checking this with a test equipment which has an uncertainty of ±5%, then the acceptance limit is the sum of the two unknowns, that is ±(10 + 5) = ±15%.

(2) A common external frequency standard, with an accuracy within ±5 parts in 10^8, should be used for the generator and any other frequency controlled test equipment.

(3) Use the shortest possible connecting leads; ideally the generator should be directly coupled to the test equipment.

(4) Allow a warm-up time of 20 minutes for the UUT (Unit Under Test) and all test gear before commencing tests.

(5) Note that the **[HARD]** keys are shown in capitals in square brackets and the [soft] keys in italics in square brackets.

RECOMMENDED TEST EQUIPMENT

The test equipment recommended for acceptance testing is shown in Table 5-1-1. Alternative equipment may be used provided it complies with the stated minimum specification.

TABLE 5-1-1 RECOMMENDED TEST EQUIPMENT

Description	Minimum specification	Example
Power meter	±0.1 dB from 10 kHz to 5.4 GHz	Marconi 6960A and 6910 or 6912 sensor
Measuring receiver	0 dBm to -127 dBm; 2.5 to 1300 MHz	HP8902A and 11722A sensor and 11793A down converter
Signal generator	8 dBm from 1.3 to 5.4 GHz	Marconi 2032
Frequency counter	10 Hz to 2.7 GHz	Marconi 2440
Audio analyzer	Capable of measuring THD below 0.03%m from100 Hz to 20 kHz. Capable of measuring 0.5 mV ±3% and levels at 10 Hz	HP8903B Rhode & Schwarz UPA3
Digital multimeter	DC to 500 kHz, 1 mV to 5 V	Datron 1061A
Modulation meter	AM, FM and ΦM. 1.5 MHz to 1 GHz. Accuracy better than 1.1%. Modulation freqs from 30 Hz to 50 kHz	Marconi 2305 plus distortion option*
Spectrum analyzer	10 kHz to 8 GHz	Marconi 2386
Function generator	DC to 500 kHz sine ±0.6 dB flatness	HP3325B

* The distortion option of the 2305 Modulation Meter allows modulation distortion tests to be carried out with greater ease. If a 2305 with a distortion option is not available, the Audio Analyzer may be connected to the Modulation Meter LF output and set to measure distortion.

TEST PROCEDURES

Before each test, it is recommended that the UUT is reset to its switch-on conditions which are as follows:

Carrier freq	1.35 GHz (2030), 2.7 GHz (2031), 5.4 GHz (2032)
RF level	-138 dBm (2030), -144 dBm (2031, 2032)
FM	0 Hz ON
Single modulation mode	
Modulation	ENABLED

RF OUTPUT

SPECIFICATION

Level range: -127 dBm to +13 dBm (usable to -144 dBm)

Accuracy:

(2030, 2031 and 2032)
±1 dB from 10 kHz to 1.35 GHz at levels >-127 dBm
±0.65 dB from 10 kHz to 1.35 GHz at levels >0 dBm

(2031 and 2032)
±2 dB from 1.35 GHz to 2.7 GHz at levels >-127 dBm
±1 dB from 1.35 GHz to 2.7 GHz at levels >0 dBm

(2032 only)
±3 dB from 2.7 GHz to 5.4 GHz at levels >-100 dBm
±2 dB from 2.7 GHz to 5.4 GHz at levels >-50 dBm
±1.5 dB from 2.7 GHz to 5.4 GHz at levels >0 dBm

TEST EQUIPMENT

Description	Minimum specification	Example
RF power meter	±0.1 dB from 30 kHz to 2.7 GHz	Marconi 6960A and 6910 or 6912 sensor
Measuring receiver	0 dBm to -127 dBm; 2.5 MHz to 1300 MHz	HP 8902A and 11722A sensor and11793A down converter
Signal generator	8 dBm from 32.5 MHz to 5.4 GHz	Marconi 2032

TEST PROCEDURES

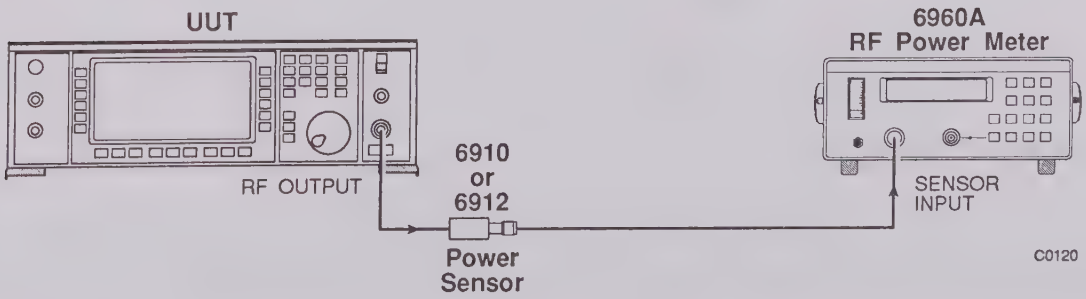


Fig. 5-1-1 RF output test set-up

(1) Connect the test equipment as shown in Fig. 5-1-1.

(2) Set the UUT to *[RF level]* 0 dBm, *[Carrier freq.]* 30 kHz.

(3) Check that the output level is within specification at the frequencies shown in Table 5-1-2.

When checking a 2032 signal generator, the 6912 sensor must be replaced with 6910 sensor for frequencies above 2700 MHz.

(4) Set the UUT RF output to 7 dBm and repeat (3) above.

(5) Set the UUT RF output to 13 dBm and repeat (3) above.

TABLE 5-1-2 FREQUENCY SETTINGS FOR OUTPUT LEVELS

FREQUENCY (MHz)				
(2030/1/2)	1125	2025	2925	4425
0.03	1275	2175	3075	4575
0.1	1350	2325	3225	4725
75		2475	3375	4875
225	**(2031/2)**	2625	3525	5025
375	1351	2700	3675	5175
525	1425		3825	5325
675	1575	**(2032)**	3975	5400
825	1725	2701	4125	
975	1875	2775	4275	

ALC linearity

(1) Connect the test equipment as shown in Fig. 5-1-1.

(2) Set the UUT to *[RF level]* 0 dBm, *[Carrier freq.]* 2.5 MHz.

(3) Increment the RF output of the UUT in 1 dB steps up to 12 dBm and in 0.1 dBm steps up to 13 dBm, measuring the RF level at each step. Check that the RF output level variation is within ±0.1 dB.

(4) Set the UUT carrier frequency to 500 MHz and repeat (3) above.

(5) Set the UUT carrier frequency to 2.7 GHz and repeat (3) above.

(6) Replace the 6912 sensor with the 6910 sensor, set the UUT carrier frequency to 5.4 GHz and repeat (3) above.

Attenuator accuracy

The following test will confirm that the attenuator performs to the published performance specification. In the event of the receiver/down converter not being available, an alternative method to functionally test the attenuator is also suggested (see 'Alternative attenuator functional check' below).

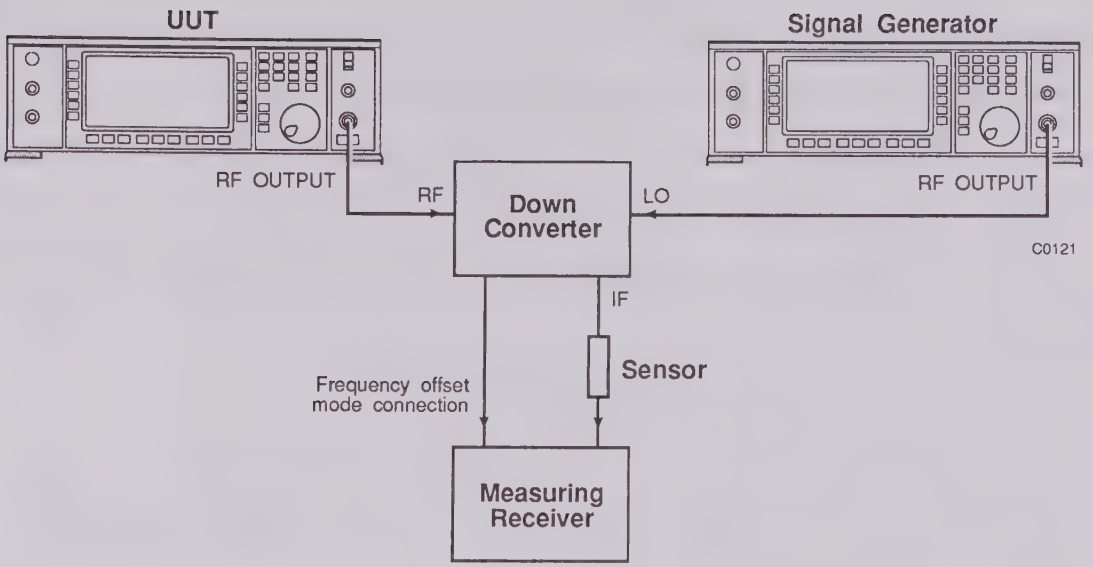


Fig. 5-1-2 Attenuator accuracy test set-up

(1) Connect the test equipment as shown in Fig. 5-1-2.

(2) Set the UUT to *[RF level]* 0 dBm, *[Carrier freq.]* 2.5 MHz.

(3) Tune the receiver to 2.5 MHz and measure the RF level.

(4) Set the UUT to *[RF level]* -6.1 dBm and measure the RF level.

(5) Decrement the output of the UUT in 6 dB steps down to an RF level of -120.1 dBm measuring the RF level at each step.

(6) Repeat (2) to (5) at the frequencies given in Table 5-1-3.

(7) Set the local oscillator to +8 dBm at the frequencies indicated in brackets in Table 5-1-3.

TABLE 5-1-3 ATTENUATOR FREQUENCY SETTINGS

Frequency (MHz)		
2030/1/2	2031/2	2032
2.5	*1725 (1662)	*2775 (2712)
31	*2700 (2637)	*4125 (4062)
325		*5400 (5337)
1125		
1275		

*At frequencies above 1300 MHz the down converter will automatically be enabled.

The frequency of the local oscillator will have to be entered on the receiver followed by the test frequency. This will automatically set the receiver to the required IF frequency.

Alternative attenuator functional check

(1) Connect the test equipment as shown in Fig. 5-1-1.

(2) Set the UUT to *[Carrier freq.]* 1.35 GHz, *[RF level]* 13 dBm.

(3) Set a reference on the power meter.

(4) Using the latch poke facility on the UUT, select each attenuator pad individually as follows:

[UTIL] *[Utils. Menu 2] [Latch Data]* 95 enter
[Decimal/Binary]

The binary latch data will now appear in the bottom right-hand side of the display.

(5) By using the *[Toggle Bit]* and the *[Cursor Left] [Cursor Right]* soft keys, select each attenuator pad in turn which should give the readings on the power meter in the following sequence:

-24 dB -36 dB -6 dB -12 dB -24 dB -36 dB

Note that no software correction is applied to the attenuator when performing this test.

CARRIER FREQUENCY ACCURACY

SPECIFICATION

Frequency range:	10 kHz to 1.35 GHz (2030) 10 kHz to 2.7 GHz (2031) 10 kHz to 5.4 GHz (2032)
Accuracy:	Equal to the frequency standard accuracy: Better than ±5 in 10^8 from 0°C to 50°C
Resolution:	0.1 Hz

TEST EQUIPMENT

Description	Minimum specification	Example
Frequency counter	10 kHz to 5.4 GHz	Marconi 2440

TEST PROCEDURES

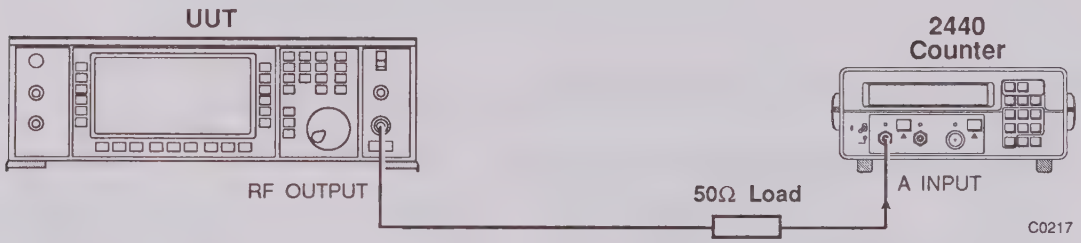


Fig. 5-1-3 Carrier frequency accuracy test set-up

(1) Connect the test equipment as shown in Fig. 5-1-3.

(2) Set the UUT to *[RF level]* 0 dBm, *[Carrier freq.]* 10 kHz.

(3) Referring to Table 5-1-4, check that the carrier frequencies can be selected correctly and are within specification. It will be necessary to disconnect the 50 ohm load and reconnect the UUT RF OUTPUT to the B input and C input where indicated.

TABLE 5-1-4 CARRIER FREQUENCIES

Carrier Frequencies (Hz)

(2030/1/2)			(2032)
A Input	**B Input**	805,306,368.0	2,700,001,000.0
		952,945,868.8	5,400,000,000.0
10,000.0	168,749,999.9	959,656,755.2	
4,226,750.0	337,499,999.9	1,134,139,801.6	
8,443,500.0	572,662,306.1	1,140,850,688.0	
12,660,250.0		1,145,324,612.2	
16,887,000.0	**C Input**	1,348,888,166.4	
21,093,749.9			
21,039,750.0	674,999,999.9	**(2031/2)**	
42,187,499.9	677,799,526.4	1,350,001,000.0	
84,374,999.9	798,595,481.6	2,700,000,000.0	

MODULATION OSCILLATOR

SPECIFICATION

Frequency range:	0.1 Hz to 500 kHz
Accuracy:	Equal to the frequency standard accuracy
Resolution:	0.1 Hz
Distortion:	Less than 0.1% THD at frequencies up to 20 kHz sine wave mode

TEST EQUIPMENT

Description	Minimum specification	Example
Frequency counter	10 Hz to 500 kHz	Marconi 2440
Audio analyzer	Capable of measuring down to 0.03% THD from 100 Hz to 20 kHz	HP 8903B Rhode & Schwarz UPA 3

TEST PROCEDURES

Modulation oscillator frequencies

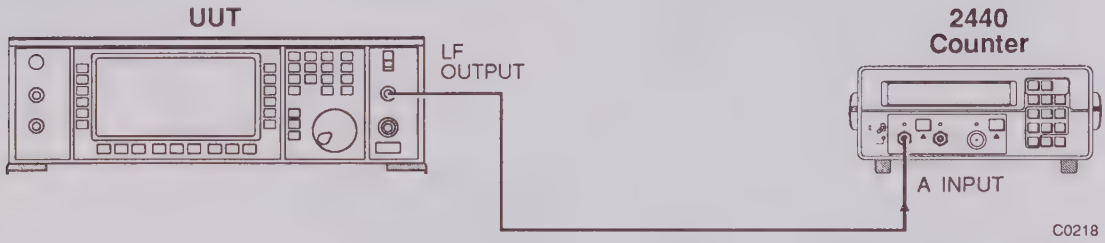


Fig. 5-1-4 Modulation oscillator frequencies test set-up

(1) Connect the test equipment as shown in Fig. 5-1-4.

(2) Set the UUT to *[Source Freq: F4]* 10 Hz.

(3) Referring to Table 5-1-5, check that the oscillator frequencies can be selected correctly and are within specification.

TABLE 5-1-5 MODULATION OSCILLATOR FREQUENCIES

Modulation oscillator frequencies (Hz)	
10.00	279,620.20
139,810.10	500,000.00

Modulation oscillator distortion

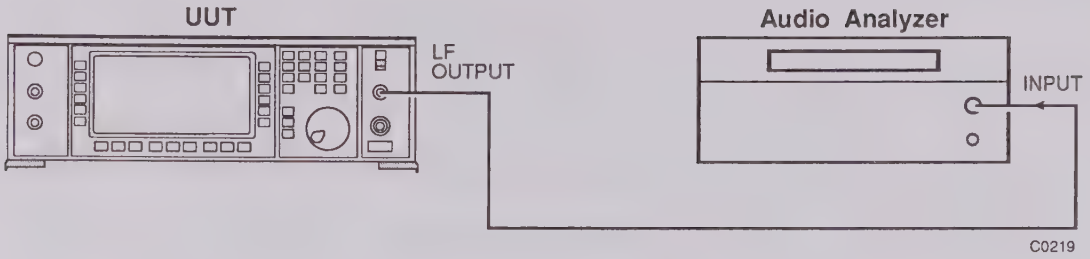


Fig. 5-1-5 Modulation oscillator distortion test set-up

(1) Connect the test equipment as shown in Fig. 5-1-5.

(2) Set the UUT to *[Source Freq: F4]* 100 Hz.

(3) Check that the distortion measured on the audio analyzer at the frequencies indicated in Table 5-1-6 is less than 0.1%.

TABLE 5-1-6 DISTORTION FREQUENCY SETTINGS

Modulation oscillator frequencies

100 Hz	10 kHz
1 kHz	20 kHz

LF OUTPUT

SPECIFICATION

Level accuracy:	±5% for levels above 50 mV ±10% for levels from 500 µV to 50 mV (With a load impedance >10 kΩ)
Frequency response:	Typically better than 1 dB from 0.1 Hz to 300 kHz

TEST EQUIPMENT

Description	Minimum specification	Example
Digital multimeter	DC to 300 kHz, 1 mV to 5 V	Datron 1061A
Audio analyzer	Capable of measuring 0.5 mV ±3% and levels at 10 Hz	HP 8903B Rhode & Schwarz UPA3

TEST PROCEDURES

Level accuracy

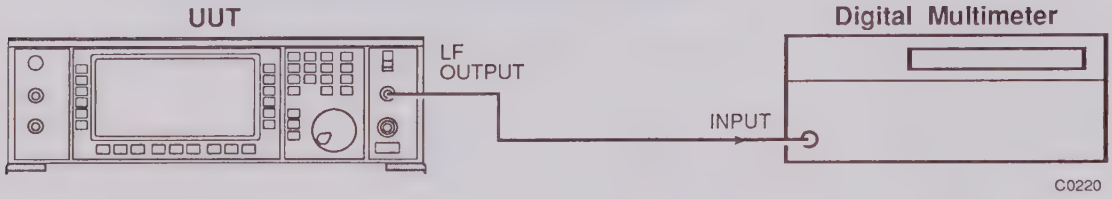


Fig. 5-1-6 Level accuracy test set-up

(1) Connect the test equipment as shown in Fig. 5-1-6.

(2) Set the UUT to give an LF output of 5 V at 1 kHz as follows:

[LF] *[LF Gen] [LF Freq]* 1 kHz *[LF Level]* 5 V

(3) The level measured on the digital multimeter should read 5 V ±0.25 V.

(4) Check the LF output of the UUT at the levels indicated in Table 5-1-7.

TABLE 5-1-7 LEVEL ACCURACY OUTPUT LEVELS

LF output levels (V)		
5.0000	0.1000	0.0050
2.0000	0.0500	0.0020
1.0000	0.0200	0.0010
0.5000	0.0100	*0.0005
0.2000		

*For the last measurement it will be necessary to use the audio analyzer. Connect the test equipment as shown in Fig. 5-1-5.

LF output frequency response

(1) Connect the test equipment as shown in Fig. 5-1-5.

(2) Set the UUT to give an LF output of 1 V at 1 kHz on the first modulation oscillator (see 'Level accuracy' (2) above).

(3) Reference this level on the audio analyzer using the dB relative function.

(4) Set the modulation oscillator to the frequencies given in Table 5-1-8 measuring the difference from the reference in (3) above which should be less than 1 dB.

TABLE 5-1-8 FREQUENCY RESPONSE TEST FREQUENCIES

Test frequencies		
10 Hz	1 kHz ref	70 kHz
30 Hz	10 kHz	100 kHz
100 Hz	30 kHz	300 kHz

EXTERNAL MODULATION

SPECIFICATION

With ALC off, the modulation is calibrated for an input level of 1.0 V PD RMS

With ALC on, the modulation is calibrated for input levels between 0.7 V and 1.4 V PD RMS

Distortion: Less than 0.1% from 50 Hz to 20 kHz at 1 V RMS

Flatness: Typical 1 dB bandwidth, 10 Hz to 500 kHz

TEST EQUIPMENT

Description	Minimum specification	Example
Function generator	10 Hz to 500 kHz sine wave ±0.6 dB flatness	HP 3325B
Digital multimeter	10 Hz to 500 kHz	Datron 1061A
Audio analyzer	Capable of measuring THD down to 0.03% from 50 Hz to 20 kHz	HP 8903B Rhode & Schwarz UPA3

TEST PROCEDURES

Mod ALC on flatness

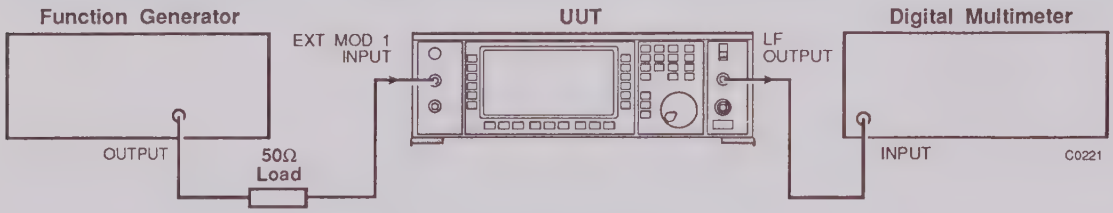


Fig. 5-1-7 External modulation test set-up

Mod input 1

(1) Connect the test equipment as shown in Fig. 5-1-7.

(2) Set the function generator to 1 V RMS sine wave output at a frequency of 1 kHz.

(3) Set the UUT to Ext mod 1 input with ALC ON as follows:

[LF] *[Mod Drive]*
[SIG GEN] *[AM]* 80% *[Select Source]*
[Select External] [Ext1 ALC Coupling] **[SIG GEN]**

(4) Set the digital multimeter to read dB and measure and record this value.

(5) Set the function generator to the frequencies given in Table 5-1-9 and measure the LF output relative to that reading taken in (4) above. The difference should be less than 1 dB.

(6) Set the function generator to give 0.7 V output and repeat (4) and (5) above.

(7) Set the function generator to give 1.4 V output and repeat (4) and (5) above.

Mod input 2

(8) Connect the test equipment as in Fig. 5-1-7 except with the function generator output connected to EXT MOD 2 INPUT on the UUT.

(9) Set the UUT to EXT MOD 2 INPUT with ALC ON as follows:

[Select source] [Ext2 ALC Coupling] **[SIG GEN]**

(10) Reset the function generator as in (2) above and repeat (4) to (7) above.

TABLE 5-1-9 EXTERNAL MODULATION FREQUENCIES

External modulation frequencies			
10 Hz	50 Hz	20 kHz	200 kHz
20 Hz	1 kHz ref	100 kHz	500 kHz

Modulation ALC distortion

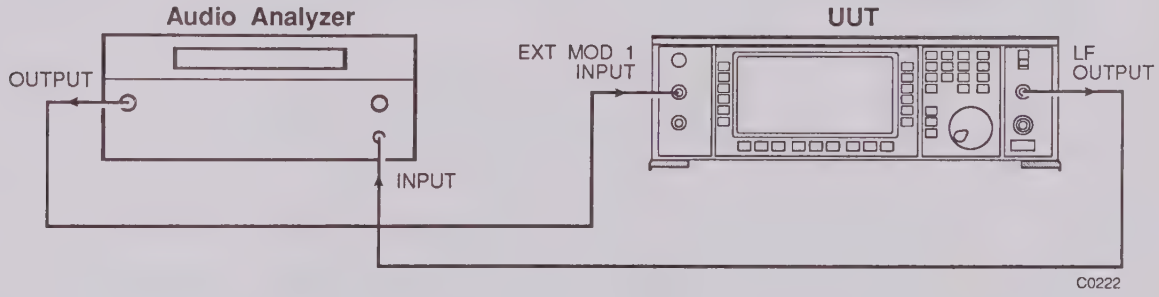


Fig. 5-1-8 Modulation ALC distortion test set-up

(1) Connect the test equipment as shown in Fig. 5-1-8.

(2) Set the UUT as in 'Mod input 1' (3) above.

(3) Set the audio analyzer to give 1 V RMS output and monitor distortion.

(4) Set the audio analyzer to 50 Hz, 1 kHz and 20 kHz measuring the distortion at each frequency which must be less than 0.1%.

(5) Connect the test equipment as in Fig. 5-1-8 except with the output from the audio analyzer connected to EXT MOD 2 INPUT on the UUT and set the UUT as in 'Mod input 2' (9) above.

(6) Repeat (4) above.

INTERNAL AM DEPTH AND DISTORTION

SPECIFICATION

Range:	0 to 99% in 0.1% steps.
Accuracy:	For carrier frequencies up to 1 GHz, ±4% of setting ±1% depth. Usable to 1.35 GHz (2030), 2.7 GHz (2031), 5.4 GHz (2032).
Envelope distortion:	Less than 3% THD for AM depths up to 80% at 1 kHz modulation frequency. Less than 1% THD for AM depths up to 30% at 1 kHz modulation frequency.
Phase mod on AM:	Typically less than 0.1 rad at 30% depth on a 500 MHz carrier.

TEST EQUIPMENT

Description	Minimum specification	Example
Modulation meter	1.5 MHz to 1 GHz. Accuracy: Better than 1.1%.	Marconi 2305 + distortion option

TEST PROCEDURES

Fig. 5-1-9 Internal AM depth and distortion test set-up

(1) Connect the test equipment as shown in Fig. 5-1-9.

(2) Set the UUT to *[RF level]* 0 dBm, *[Carrier freq.]* 1.5 MHz, *[AM]* 30%.

(3) Measure the AM depth and the envelope distortion on the modulation meter using the 50 Hz to 15 kHz filter setting at the frequencies shown in Table 5-1-10.

(4) Set the UUT to an AM depth of 80% and repeat (3) above.

(5) Set the UUT to *[RF level]* 7 dBm and repeat (3) and (4) above.

TABLE 5-1-10 AM DEPTH AND DISTORTION FREQUENCIES

Carrier frequencies (MHz)	
1.5	400
31.0	500
43.0	850
200.0	1000

AM scale shape

(1) Connect the test equipment as shown in Fig. 5-1-9.

(2) Set the UUT to *[RF level]* 0 dBm, *[Carrier freq.]* 100 MHz, *[AM]* 1%.

(3) Measure the AM on the modulation meter at the depths shown in Table 5-1-11.

TABLE 5-1-11 AM DEPTHS

AM depth (%)									
1	10	31	34	37	39.1	39.4	39.7	40	70
2	20	32	35	38	39.2	39.5	39.8	50	80
5	30	33	36	39	39.3	39.6	39.9	60	85

Phase modulation on AM

(1) With the test equipment set up as in Fig. 5-1-9, set the UUT to *[Carrier freq.]* 500 MHz, *[RF level]* 0 dBm, *[AM]* 30%.

(2) Measure the incidental phase modulation which should be typically less than 0.1 radian in a 50 Hz to 15 kHz bandwidth.

EXTERNAL AM

SPECIFICATION

Accuracy:	With ALC OFF the modulation is calibrated for an input level of 1.0 V PD RMS sine wave.
Bandwidth:	Typically ±1 dB DC to 50 kHz, relative to 1 kHz. ±1 dB, DC to 30 kHz relative to 1 kHz ±2 dB, DC to 50 kHz relative to 1 kHz

TEST EQUIPMENT

Description	Minimum specification	Example
Modulation meter	Modulation frequencies from 30 Hz to 50 kHz.	Marconi 2305
Function generator	DC to 50 kHz.	HP3325B
Power meter	Capable of measuring levels at 400 MHz.	Marconi 6960A and 6912 sensor

TEST PROCEDURES

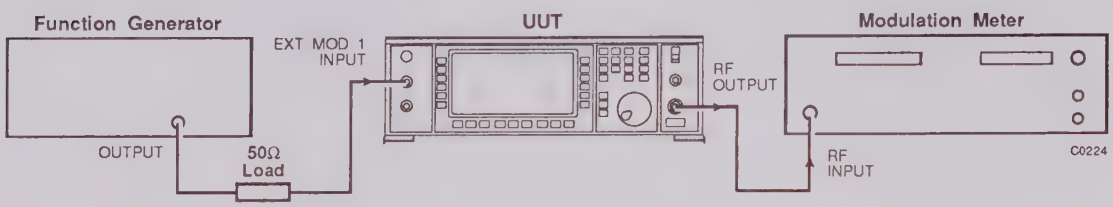


Fig. 5-1-10 External AM test set-up

(1) Connect the test equipment as shown in Fig. 5-1-10.

(2) Set the UUT to *[RF level]* 7 dBm, *[Carrier freq.]* 400 MHz, *[AM]* 80%. Then select EXT MOD 1 INPUT, DC coupled as follows:

[Select Source] [Select External] [Ext1 DC Coupling]
[SIG GEN]

(3) Set the function generator to give 1 V RMS at 1 kHz sine wave.

(4) With the modulation meter set to measure AM, set a reference using the relative function.

(5) Set the function generator to the frequencies shown in Table 5-1-12 and measure the change in external AM response which should be less than 1 dB with respect to 1 kHz.

TABLE 5-1-12 EXTERNAL AM TEST FREQUENCIES

Modulation frequency		
100 Hz	1 kHz	30 kHz
300 Hz	10 kHz	50 kHz

INTERNAL FM DEVIATION

SPECIFICATION

Range:	1 MHz max for frequencies up to 21.09375 MHz. Up to 1% of carrier frequency for carrier frequencies above 21.09375 MHz.
Resolution:	3 digits.
Accuracy:	±5% of indication ±10 Hz at 1 kHz rate internal modulation source.
Distortion:	Less than 3% at maximum deviation for modulation frequencies up to 20 kHz.

TEST EQUIPMENT

Description	Minimum specification	Example
Modulation meter	Minimum frequency 20 MHz	Marconi 2305 + distortion option

TEST PROCEDURES

(1) Connect the test equipment as shown in Fig. 5-1-9.

(2) Set the UUT to *[Carrier freq.]* 21 MHz, *[RF level]* 0 dBm, *[FM devn.]* 210 kHz. Measure the FM deviation on the modulation meter.

(3) Set up a carrier frequency step on the UUT of 1 MHz as follows:

[Δ] *[Set steps] [Carrier step]* 1 MHz **[SIG GEN]**

(4) Set up an FM deviation of 500 kHz and increment the carrier frequency up to 42 MHz using the '↑' key, measuring the deviation and distortion on the modulation meter at each step. (Note that the deviation will automatically be limited to 1% of the carrier frequency for each step.)

FM attenuator

(1) With the test equipment connected as in Fig. 5-1-9, set the UUT to *[Carrier freq.]* 31.64 MHz, *[RF level]* 0dBm, *[FM devn.]* 1,260 Hz.

(2) Measure the FM on the modulation meter at the deviations indicated in Table 5-1-13.

TABLE 5-1-13 FM ATTENUATOR DEVIATIONS

Deviation (kHz)		
1.26	79	224
20	159	316

FM scale shape

(1) With the test equipment connected as in Fig. 5-1-9, set the UUT to *[Carrier freq.]* 31.64 MHz, *[RF level]* 0 dBm, *[FM Devn.]* 224 kHz.

(2) Referring to Table 5-1-14, measure the FM on the modulation meter at the deviations indicated.

TABLE 5-1-14 FM SCALE SHAPE DEVIATIONS

Deviation (kHz)		
224	256	289
228	261	293
233	265	298
238	270	302
242	275	307
247	279	312
252	284	316

EXTERNAL FM

SPECIFICATION

Accuracy:	With ALC OFF the modulation is calibrated for an input level of 1.0 V PD RMS sine wave.
±1 dB bandwidth:	DC to 300 kHz. Typically 500 kHz.

TEST EQUIPMENT

Description	Minimum specification	Example
Modulation meter	Modulation frequencies from 30 Hz to 50 kHz.	Marconi 2305
Function generator	DC to 300 kHz sine wave.	HP3325B
Frequency counter	Up to 40 MHz.	Marconi 2440

TEST PROCEDURES

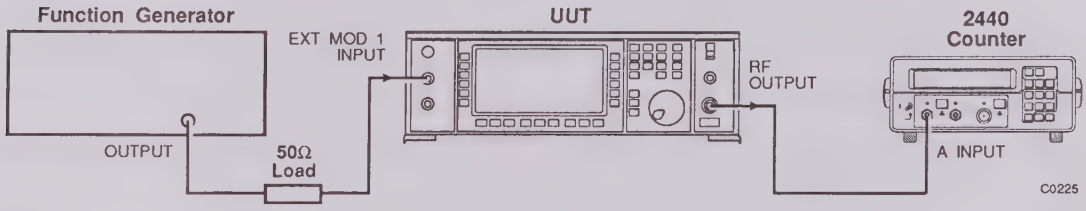


Fig. 5-1-11 External FM test set-up

(1) Connect the test equipment as shown in Fig. 5-1-10.

(2) Set the UUT to *[Carrier freq.]* 35,468,750.1 Hz, *[RF level]* 0 dBm, *[FM Devn.]* 40 kHz.

[UTIL] *[Mod'n mode] [Comp]*
[SIG GEN] *[Select Source] [Select External]*
[Ext1 AC Coupling]
[SIG GEN] *[FM2] [Select Source] [Ext2 AC Coupling]*
[SIG GEN] 40 kHz *[FM1]* 40 kHz

The UUT will now produce FM when the external modulating source is applied to either modulation input.

(3) Set the function generator to give 1 V RMS at 1 kHz sine wave.

(4) With the modulation meter set to measure FM, set a reference using the relative function.

(5) Set the function generator to the frequencies shown in Table 5-1-15 and measure the change in external FM response which should be less than 1 dB with respect to 1 kHz.

(6) To measure the FM deviation at DC, it will be necessary to connect the test equipment as shown in Fig. 5-1-11 and DC couple the EXT MOD 1 INPUT as follows:

[Select source] [Ext1 DC Coupling] **[SIG GEN]**

(7) Using the DC offset facility on the function generator, set up a voltage of +1.4142 V (i.e. $\sqrt{2}$).

(8) Measure and record the frequency indicated on the counter (F1).

(9) Set the function generator to give a DC voltage of -1.4142 V.

(10) Measure and record the frequency indicated on the counter (F2).

(11) Calculate the FM deviation using the following formula:

$$\frac{F1-F2}{2} = \text{Measured dev} = FM1$$

(12) It will now be necessary to reconnect the test equipment as shown in Fig. 5-1-10, reset the function generator to 1 kHz and measure the FM deviation on the modulation meter (FM2).

(13) Using the following formula, calculate the change in response which should be less than 1 dB:

$$20 \log_{10} \frac{FM2}{FM1}$$

(14) Transfer the function generator output to EXT MOD 2 INPUT on the UUT, select *[FM2]* and repeat (3) to (13) above.

TABLE 5-1-15 EXTERNAL FM RESPONSE FREQUENCIES

Modulating frequency (Hz)				
0	100	1,000	50,000	200,000
30	300	10,000	100,000	275,000

CARRIER FREQUENCY OFFSET

SPECIFICATION

In DC FM mode; less than ±(1 Hz +0.1% of the set deviation)

TEST EQUIPMENT

Description	Minimum specification	Example
Frequency counter	Up to 40 MHz.	Marconi 2440

TEST PROCEDURES

(1) Connect the test equipment as shown in Fig. 5-1-4.

(2) Short circuit the EXT MOD 1 INPUT.

(3) Set the UUT to *[Carrier freq.]* 1.35 GHz, *[RF level]* 0 dBm, *[FM Devn.]* 13.5 MHz, then proceed as follows:

[Select Source] [Select External] [Ext1 AC Coupling] **[SIG GEN]**

(4) Measure and record the carrier frequency on the counter.

(5) Set the UUT to DC coupled EXT MOD 1 INPUT as follows:

[Select Source] [Ext1 DC Coupling] **[SIG GEN]**

(6) Measure the change in carrier frequency (offset) which must be less than 13,501 Hz.

(7) Change the settings of the UUT as follows:

[Select Source] [Ext2 AC Coupling] **[SIG GEN]**

(8) Short circuit the EXT MOD 2 INPUT.

(9) After a 10 second settling period, measure and record the carrier frequency on the counter.

(10) Set the UUT to DC coupled EXT MOD 2 INPUT as follows:

[Select Source] [Ext2 DC Coupling] **[SIG GEN]**

(11) Measure the change in carrier frequency (offset) which must be less than 13,501 Hz.

INTERNAL PHASE MODULATION

SPECIFICATION

Range:	Up to 10 radians in 0.01 radian steps
Accuracy:	Better than ±5% at 1 kHz
Distortion:	Less than 3% at 1 kHz modulation rate
Bandwidth:	±3 dB, 100 Hz to 10 kHz

TEST EQUIPMENT

Description	Minimum specification	Example
Modulation meter	Minimum frequency 20 MHz	Marconi 2305 + distortion option

TEST PROCEDURES

(1) Connect the test equipment as shown in Fig. 5-1-9.

(2) Set the UUT to *[Carrier freq.]* 21,093,750.1 Hz, *[RF level]* 0 dBm, *[ΦM]* 10 rad.

(3) Measure the phase modulation on the modulation meter which should read 10 rad ±0.5 rad.

Internal phase modulation flatness

(1) Connect the test equipment as shown in Fig. 5-1-9.

(2) Set the UUT to *[Carrier freq.]* 21,093,750.1 Hz, *[RF level]* 0 dBm, *[ΦM]* 10 rad.

(3) With the modulation meter set to measure phase modulation, set a reference using the relative function.

(4) Select the modulation source frequencies as shown in Table 5-1-16 using *[Select source: F4]* on the UUT, then enter the frequency.

(5) Measure the change in response which should be less than 1 dB with respect to 1 kHz.

(6) Reset the modulation frequency on the UUT to 1 kHz.

(7) Using the modulation meter measure the distortion which must be less than 3%.

TABLE 5-1-16 MODULATION SOURCE FREQUENCIES

Modulating frequency (Hz)		
100	1,000	10,000
300	3,000	

SPECTRAL PURITY

SPECIFICATION

Harmonically related signals:	Less than -30 dBc for signal levels up to +7 dBm and carrier frequencies up to 1 GHz. Less than -27 dBc for carrier frequencies up to 2.7 GHz (2031and 2032). Less than -27 dBc for carrier frequencies up to 5.4 GHz (2032 only).
Sub-harmonics:	Less than -90 dBc for carrier frequencies up to 1.35 GHz. Less than -40 dBc for carrier frequencies up to 2.3 GHz (2031 and 2032). Less than -30 dBc for carrier frequencies up to 2.7 GHz (2031 and 2032). Less than -30 dBc for carrier frequencies up to 5.4 GHz (2032 only).
Non-harmonics:	Less than -70 dBc for carrier frequencies up to 2.7 GHz at offsets of 3 kHz or greater. Less than -64 dBc for carrier frequencies up to 5.4 GHz (2032 only).
Residual FM:	Less than 7 Hz RMS in a 0.3 to 3.4 kHz unweighted bandwidth at a 470 MHz carrier.

TEST EQUIPMENT

Description	Minimum specification	Example
Modulation meter	Capable of measuring Residual FM less than 7 Hz	Marconi 2305
Spectrum analyzer	10 kHz to 16.2 GHz frequency coverage	Marconi 2386

TEST PROCEDURES

Residual FM

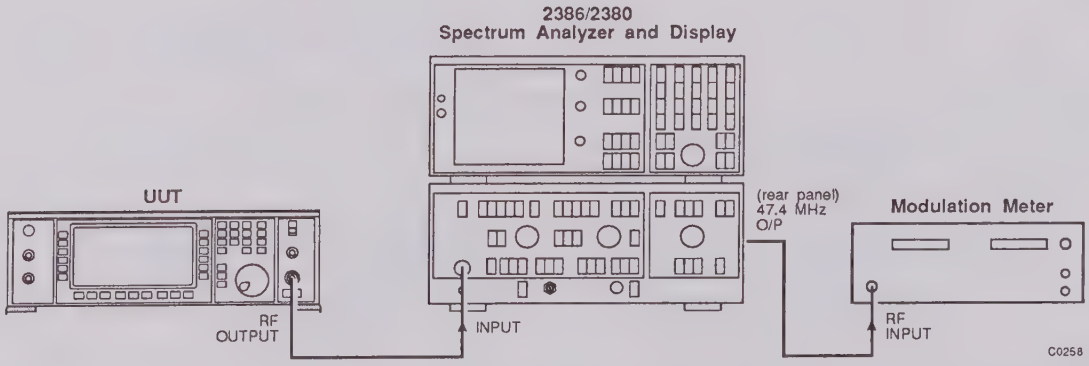


Fig. 5-1-12 Residual FM test set-up

(1) Connect the test equipment as shown in Fig. 5-1-12.

(2) Set the UUT to *[Carrier freq.]* 470 MHz, *[RF level]* 0 dBm, modulation OFF.

(3) Set the spectrum analyzer to 470 MHz zero span.

(4) Measure the residual FM on the modulation meter in a 300 Hz to 3.4 kHz bandwidth, which must be less than 7 Hz.

Carrier harmonics

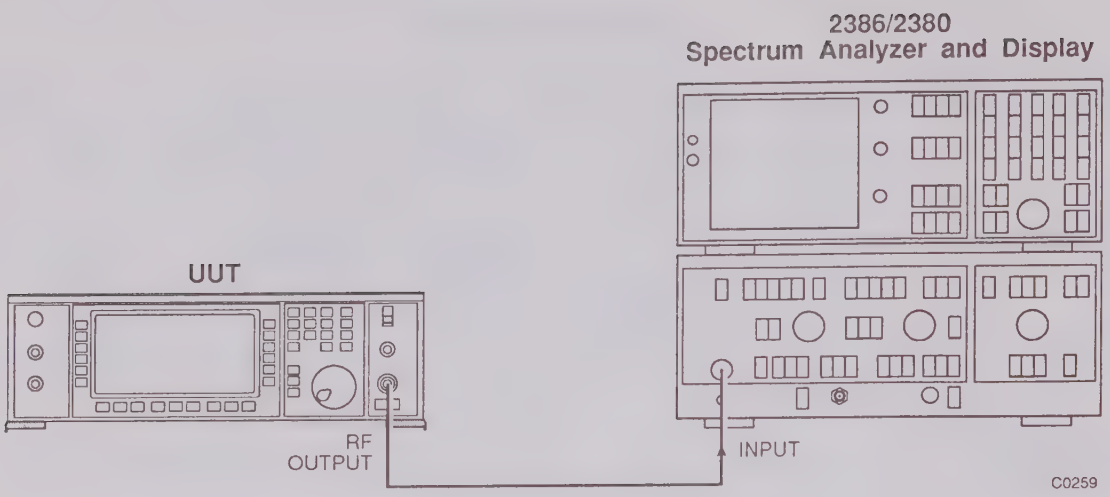


Fig. 5-1-13 Carrier harmonics test set-up

(1) Connect the test equipment as shown in Fig. 5-1-13.

(2) Set the UUT to *[Carrier freq.]* 10 kHz, *[RF level]* 0 dBm.

(3) On the spectrum analyzer measure the 2nd and 3rd harmonics of the carrier frequency which must be less than -30 dBc for carrier frequencies up to 1 GHz and less than -27 dBc for carrier frequencies above 1 GHz.

(4) Set the UUT to the frequencies indicated in Table 5-1-17 and repeat (3) above.

TABLE 5-1-17 CARRIER HARMONIC FREQUENCIES

Carrier frequencies (Hz)			
(2030/1/2)			
10,000.0	42,187,500.1		
100,000.0	84,375,000.3	(2031/2)	(2032 only)
10,000,000.0	168,750,000.5	1,350,000,001.0	2,700,000,001.0
20,000,000.0	337,500,001.1	1,920,000,000.0	4,050,000,000.0
21,093,750.1	675,000,002.1	2,699,999,999.0	5,400,000,000.0

Carrier sub-harmonics (2031 and 2032 only)

(1) Connect the test equipment as shown in Fig. 5-1-13.

(2) Set the UUT to *[RF level]* +13 dBm, *[Carrier freq.]* 1,350,100,000.0 Hz.

(3) Referring to Table 5-1-18, measure the level of the sub-harmonics on the spectrum analyzer at the frequencies indicated.

TABLE 5-1-18 CARRIER SUB-HARMONIC FREQUENCIES

UUT carrier frequency (Hz)	Spectrum analyzer frequency (Hz) $\frac{fc}{2}$	$\frac{3fc}{2}$
(2031/2)		
1,350,100,000.0	675,050,000.0	2,025,150,000.0
1,500,000,000.0	750,000,000.0	2,250,000,000.0
2,000,000,000.0	1,000,000,000.0	3,000,000,000.0
2,299,999,990.0	1,149,999,995.0	3,449,999,985.0
2,300,000,010.0	1,150,000,005.0	3,450,000,015.0
2,649,000,000.0	1,324,500,000.0	3,973,500,000.0
2,700,000,000.0	1,350,000,000.0	4,050,000,000.0

	$\frac{fc}{4}$ and $\frac{3fc}{4}$	$\frac{fc}{2}$ and $\frac{5fc}{4}$
(2032)		
2,701,000,000.0	675,250,000.0	1,350,500,000.0
	2,025,750,000.0	3,376,250,000.0
3,375,000,000.0	843,750,000.0	1,687,500,000.0
	2,531,250,000.0	4,218,750,000.0
4,050,000,000.0	1,012,500,000.0	2,025,000,000.0
	3,037,500,000.0	5,062,500,000.0
4,725,000,000.0	1,181,250,000.0	2,362,500,000.0
	3,543,750,000.0	5,906,250,000.0
5,400,000,000.0	1,350,000,000.0	2,700,000,000.0
	4,050,000,000.0	6,750,000,000.0

Non-harmonics

(1) Connect the test equipment as shown in Fig. 5-1-13.

(2) Set the UUT to *[RF level]* 0 dBm, *[Carrier freq.]* 10 kHz.

(3) Set the spectrum analyzer to a span of 100 Hz, 10 Hz filter, and referring to Table 5-1-19, measure the level of the non-harmonics at the frequencies indicated ensuring that the levels measured are less than -70 dBc.

TABLE 5-1-19 CARRIER NON-HARMONIC FREQUENCIES

UUT carrier frequency (Hz)	Spectrum analyzer frequency (Hz)
10,000.0	104,867,600.0
1,000,000.0	105,857,600.0
20,000,000.0	124,857,600.0
21,093,749.0	125,951,349.0
200,000,000.0	104,867,600.0
1,350,000,000.0	1,348,322,280.0 & 1,351,677,720.0

Chapter 5-1
Appendix A

ACCEPTANCE TESTING
SECOND MODULATION OSCILLATOR OPTION

MODULATION OSCILLATORS

The following tests are for a 2030, 2031 or 2032 with the 2nd modulation oscillator fitted.

SPECIFICATION

Frequency range:	0.1 Hz to 500 kHz
Accuracy:	Equal to the frequency standard accuracy
Resolution:	0.1 Hz
Distortion:	Less than 0.1% THD at frequencies up to 20 kHz sine wave mode

TEST EQUIPMENT

Description	Minimum specification	Example
Frequency counter	10 Hz to 500 kHz	Marconi 2440
Audio analyzer	Capable of measuring down to 0.03% THD from 100 Hz to 20 kHz	HP 8903B Rhode & Schwarz UPA 3

TEST PROCEDURES

Modulation oscillator frequencies

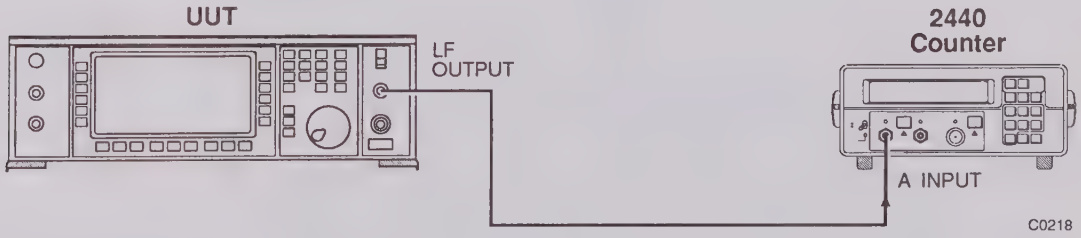


Fig. 5-1-A-1 Modulation oscillator frequencies test set-up

(1) Connect the test equipment as shown in Fig. 5-1-A-1.

(2) To enable both the modulation oscillators on the UUT, it will be necessary to carry out the following procedure:-

Press the following sequence of keys:

[UTIL] *[Mod'n Mode] [Comp]* **[SIG GEN]** *[Source Freq:]*

The frequencies of the first modulation oscillator may now be entered.

(3) Referring to Table 5-1-A-1, check that the oscillator frequencies can be selected correctly and are within specification.

(4) To monitor the second modulation oscillator, enter the following:

[FM2] [Select Source] [Select Internal] [Internal F1]
[LF] *[Mod2 Source]* **[SIG GEN]** *[Source Freq:]*

The frequencies of the second modulation may now be entered.

(5) Repeat (3) above.

TABLE 5-1-A-1 MODULATION OSCILLATOR FREQUENCIES

Modulation oscillator frequencies (Hz)	
10.00	279,620.20
139,810.10	500,000.00

Modulation oscillator distortion

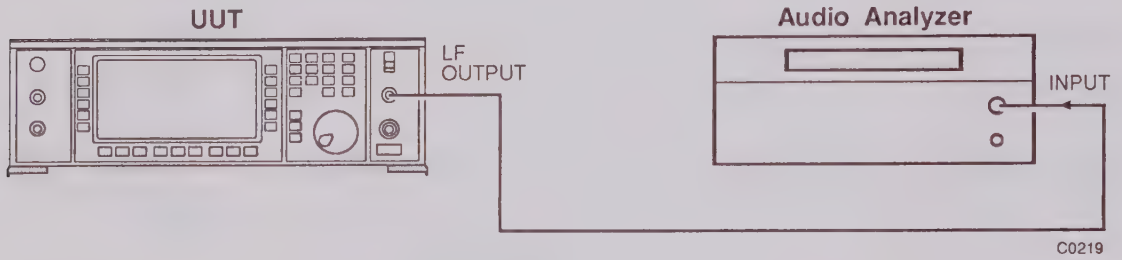


Fig. 5-1-A-2 Modulation oscillator distortion test set-up

(1) Connect the test equipment as shown in Fig. 5-1-A-2.

(2) Set the UUT such that the first modulation oscillator may be tested (refer to 'Modulation oscillator frequencies' step (2) above).

(3) Check that the distortion measured on the audio analyzer at the frequencies indicated in Table 5-1-A-2 is less than 0.1%.

(4) Set the UUT such that the second modulation oscillator may be tested (refer to 'Modulation oscillator frequencies' step (4) above).

(5) Repeat (3) above.

TABLE 5-1-A-2 DISTORTION FREQUENCIES

Modulation oscillator frequencies	
100 Hz	10 kHz
1 kHz	20 kHz

LF OUTPUT

SPECIFICATION

Level accuracy:	±5% for levels above 50 mV, ±10% for levels from 500 µV to 50 mV (with a load impedance >10 kΩ)
Frequency response:	Typically better than 1 dB from 0.1 Hz to 300 kHz

TEST EQUIPMENT

Description	Minimum specification	Example
Digital multimeter	DC to 300 kHz, 1 mV to 5 V	Datron 1061A
Audio analyzer	Capable of measuring 0.5 mV ±3% and levels at 10 Hz	HP8903B Rhode & Schwarz UPA3

TEST PROCEDURES

Level accuracy

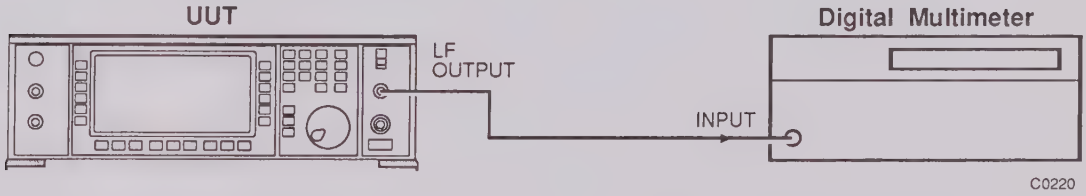


Fig. 5-1-A-3 Level accuracy test set-up

(1) Connect the test equipment as shown in Fig. 5-1-A-3.

(2) Set the UUT to give an LF output of 5 V at 1 kHz by entering the following:

[LF] *[LF Gen] [LF Freq]* 1 kHz, *[LF Level]* 5 V

(3) The level measured on the digital multimeter should read 5 V ±0.25 V.

(4) Check the LF output of the UUT at the levels indicated in Table 5-1-A-3.

TABLE 5-1-A-3 LF OUTPUT LEVELS

LF Output Levels (V)		
5.0000	0.1000	0.0050
2.0000	0.0500	0.0020
1.0000	0.0200	0.0010
0.5000	0.0100	*0.0005
0.2000		

*For the last measurement it will be necessary to use the audio analyzer. Connect the test equipment as shown in Fig. 5-1-A-4.

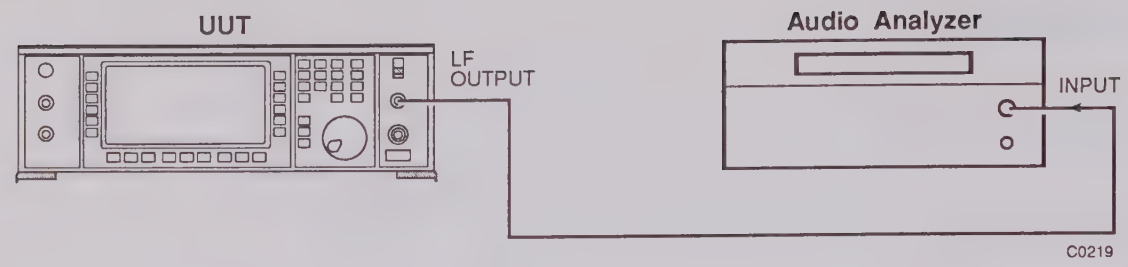


Fig. 5-1-A-4 LF output levels test set-up for 0.0005 V

Frequency response

(1) Connect the test equipment as shown in Fig. 5-1-A-2.

(2) Set the UUT to give an LF output of 1 V at 1 kHz on the first modulation oscillator (refer to 'Level accuracy' above).

(3) Reference this level on the audio analyzer using the dB relative function.

(4) Set the modulation oscillator to the frequencies given in Table 5-1-A-4 measuring the difference from the reference in (3) above which should be less than 1 dB.

(5) Set the UUT to give an LF output of 1 V at 1 kHz on the second modulation oscillator (refer to 'Level accuracy' above).

(6) Repeat (3) and (4) above.

TABLE 5-1-A-4 TEST FREQUENCIES

Test frequencies		
10 Hz	1 kHz ref	70 kHz
30 Hz	10 kHz	100 kHz
100 Hz	30 kHz	300 kHz

AM SCALE SHAPE

Fig. 5-1-A-5 AM scale shape test set-up

(1) Connect the test equipment as shown in Fig. 5-1-A-5.

(2) Set the UUT to *[RF level]* 0 dBm, *[Carrier freq.]* 100 MHz, then enter the following:

[UTIL] *[Mod'n mode] [Comp]*
[SIG GEN] *[AM]* 1%

(3) Measure the AM on the modulation meter at the depths shown in Table 5-1-A-5.

(4) Set the UUT by entering the following:

[AM1 ON/OFF] [AM2] [Select Source] [Select internal]
[Internal F4] **[SIG GEN]** 1%

(5) Repeat (3) above.

TABLE 5-1-A-5 AM DEPTHS

AM depth (%)									
1	10	31	34	37	39.1	39.4	39.7	40	70
2	20	32	35	38	39.2	39.5	39.8	50	80
5	30	33	36	39	39.3	39.6	39.9	60	85

FM SCALE SHAPE

(1) With the test equipment connected as in Fig. 5-1-A-5, set the UUT to *[Carrier freq.]* 31.64 MHz, *[RF level]* 0 dBm then enter the following:

[UTIL] *[Mod'n Mode] [Comp]*
[SIG GEN] *[FM2] [Select Source] [Select Internal]*
[Internal F4]
[SIG GEN] *[FM1]*

(2) The deviation for FM1 can now be entered. Referring to Table 5-1-A-6, measure the FM on the modulation meter at the deviations indicated.

(3) Set FM1 to 0 Hz deviation and select *[FM2]*.

(4) The deviation for FM2 can now be entered. Repeat (2) above.

TABLE 5-1-A-6 DEVIATION FREQUENCIES

Deviation (kHz)		
224	256	289
228	261	293
233	265	298
238	270	302
242	275	307
247	279	312
252	284	316

Chapter 5-1
Appendix B

ACCEPTANCE TESTING
PULSE MODULATION OPTION

PULSE MODULATION

The following tests are for a 2030, 2031 or 2032 with the pulse modulation option fitted.

SPECIFICATION

Maximum input level:	+5 V.
Minimum ON Level:	+3.5 V.
Maximum OFF level:	+1.0 V.
OFF/ON ratio :	Greater than 70 dB at the carrier frequency. Typically greater than 80 dB.
Additional output level error :	Less than 0.5 dB.

TEST EQUIPMENT

Description	Minimum specification	Example
Power meter	±0.1 dB from 30 kHz to 2.7 GHz.	Marconi 6960A and 6912 sensor
Spectrum analyzer	Frequencies up to 1.4 GHz. Capable of measuring <-70 dBm.	Marconi 2386
Function generator	DC capability.	HP3325B

TEST PROCEDURES

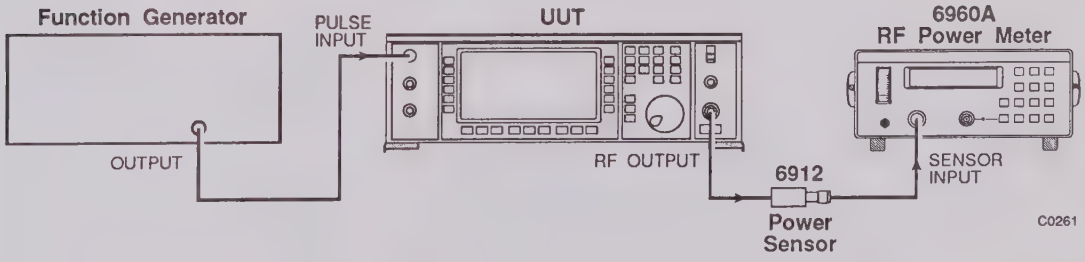


Fig. 5-1-B-1 Levels test set-up

Minimum 'ON' level

(1) Connect the test equipment as shown in Fig. 5-1-B-1.

(2) Set the UUT to *[RF level]* 0 dBm *[Carrier freq.]* 10 MHz and *[Pulse Mod.]*.

(3) Set the function generator to give +3.5 V DC. The 0 dBm level should now appear on the power meter.

Maximum 'OFF' level

(4) Set the function generator to give 1.0 V DC. The 0 dBm level should now disappear from the power meter.

Additional level error

(1) Set the UUT to *[Carrier Freq.]* 1 MHz, *[RF level]* 0 dBm.

(2) Measure and record the RF level indicated on the power meter (P1).

(3) Set the UUT to *[Pulse Mod.]*

(4) Set the function generator to give +5 V DC.

(5) Measure and record the RF level indicated on the power meter (P2).

(6) The difference between P1 and P2 must be less than 0.5 dBm.

ON/OFF ratio

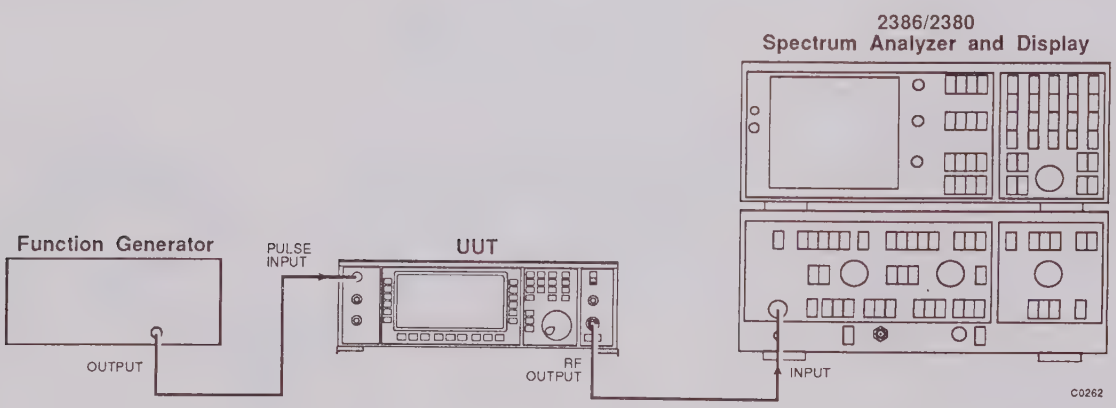


Fig. 5-1-B-2 ON/OFF ratio test set-up

(1) Connect the test equipment as shown in Fig. 5-1-B-2.

(2) Set the UUT to *[Carrier Freq.]* 11 MHz, (RF level) 0 dBm, and *[Pulse Mod]*.

(3) Set the function generator to give +5 VDC.

(4) Set the spectrum analyzer to 11 MHz, span/div 10 kHz, and, using the 'Peak Find' facility, measure the amplitude of the carrier signal and record as (P1).

(5) Set the function generator to give 0 V DC.

(6) Measure the amplitude of the carrier signal and record as (P2). The difference between P1 and P2 must be greater than 70 dB.

(7) Repeat (3) to (6) above for the UUT and spectrum analyzer frequencies shown in Table 5-1-B-1.

TABLE 5-1-B-1 ON/OFF RATIO CARRIER FREQUENCIES

Carrier frequencies		
11 MHz	675 MHz	1.349,999 GHz
111 MHz	1 GHz	

Chapter 5-1
Appendix C

ACCEPTANCE TESTING
HIGH OUTPUT POWER OPTION

RF OUTPUT

The following tests are for a 2030 fitted with the +19 dBm option (high output power).

SPECIFICATION

Level range:	-138 dBm to +19 dBm.
Accuracy :	±1.2 dB from 10 kHz to 1.35 GHz.

TEST EQUIPMENT

Description	Minimum specification	Example
RF power meter	±0.1 dB from 30 kHz to 2.7 GHz.	Marconi 6960A and 6912 sensor

TEST PROCEDURES

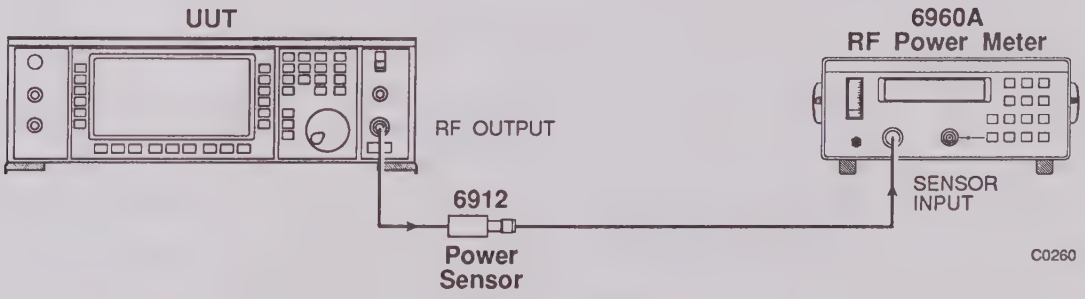


Fig. 5-1-C-1 RF output and ALC linearity test set-up

(1) Connect the test equipment as shown in Fig. 5-1-C-1.

(2) Set the UUT to *[RF level]* 6.1 dBm, *[Carrier freq.]* 30 kHz.

(3) Check that the output level is within ±1.2 dBm at the frequencies shown in Table 5-1-C-1.

(4) Set the UUT RF output to 13 dBm and repeat (3) above.

(5) Set the UUT RF output to 19 dBm and repeat (3) above.

TABLE 5-1-C-1 RF OUTPUT TEST FREQUENCIES

Frequency (MHz)	
0.03	675
0.1	825
75	975
225	1125
375	1275
525	1350

ALC linearity

(1) Connect the test equipment as shown in Fig. 5-1-C-1.

(2) Set the UUT to *[Carrier freq.]* 2.5 MHz, *[RF level]* 6 dBm.

(3) Increment the RF output of the UUT in 1 dB steps up to 18 dBm and in 0.1 dBm steps up to 19 dBm, measuring the RF level at each step.

(4) Set the UUT carrier frequency to 500 MHz and repeat (3) above.

(5) Set the UUT carrier frequency to 1.35 GHz and repeat (3) above.

CARRIER HARMONICS

SPECIFICATION

Harmonically related signals: Less than -27 dBc for carrier frequencies up to 1.35 GHz.

TEST EQUIPMENT

Description	Minimum specification	Example
Spectrum analyzer	10 kHz to 4.1 GHz frequency coverage.	Marconi 2386

TEST PROCEDURES

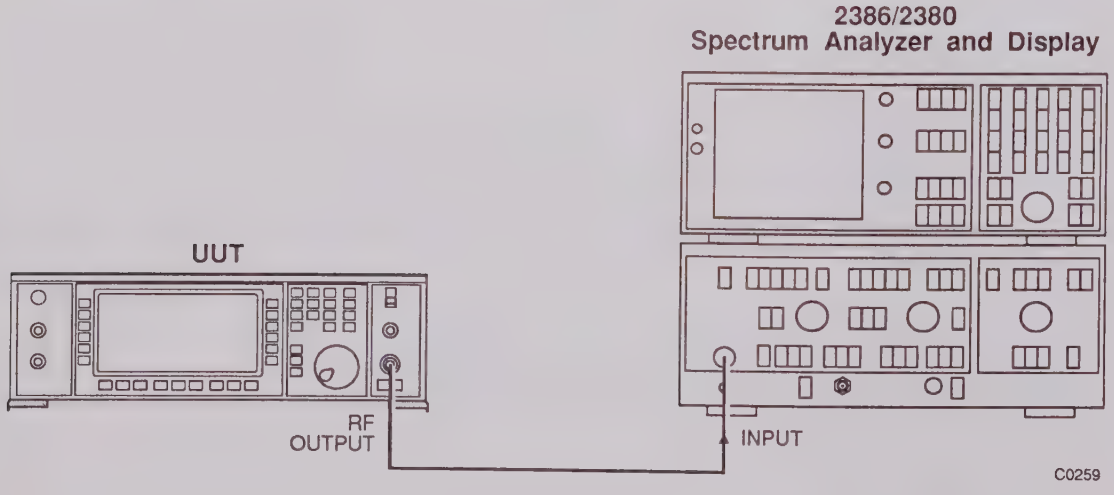


Fig. 5-1-C-2 Carrier harmonics test set-up

(1) Connect the test equipment as shown in Fig. 5-1-C-2.

(2) Set the UUT to *[Carrier freq.]* 10 kHz, *[RF level]* 0 dBm.

(3) On the spectrum analyzer measure the 2nd and 3rd harmonics of the carrier frequency which must be less than -27 dBc.

(4) Set the UUT to the frequencies indicated in Table 5-1-C-2 and repeat (3) above.

TABLE 5-1-C-2 CARRIER HARMONIC FREQUENCIES

Carrier frequencies (Hz)	
10,000.0	42,187,500.1
100,000.0	84,375,000.3
10,000,000.0	168,750,000.5
20,000,000.0	337,500,001.1
21,093,750.1	675,000,002.1

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